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UDC 534.2:535.42

WAVEGUIDE-OPTICAL READOUT OF SIGNALS IN SURFACE-ACOUSTIC-WAVE DEVICES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 19 Oct 81) pp 984-992

BESSONOV, A.F., DERYUGIN, L.N. and KOMOTSKIY, V.A.

[Abstract] Readout of radio signals from a photodetector at the carrier frequency in SAW devices by means of a stationary diffraction grating and a light beam is analyzed. The light beam propagates along the surface through an optical waveguide. The main advantage of a surface waveguide over a volume waveguide is a larger depth of space-phase modulation and thus a higher signal transmission coefficient, without reflections. The performance characteristics of this indirect optical readout system, small-signal transmission coefficient and output power, are calculated on the basis of the Raman-Hata condition for diffraction and the photodetector current resulting from interaction of the waveguide optical wave with the traveling surface acoustic wave and the stationary reference grating. The photodetector current has a constant component and an alternating one. The two principal sources of noise voltage are thermal noise in the load resistance and shot noise in the photocurrent. The performance characteristics, signal transmission coefficient and signal-to-noise ratio, are comparable with or better than those of readout by means of a Mach-Zander waveguide optical interferometer and direct readout by means of a piezoelectric interdigital transducer. An additional advantage is the possibility of signal amplification by the external source of the reading light beam. Figures 5; references 10: 4 Russian, 6 Western (3 in translation).
[261-2415]

UDC 621.396.6:621.396.946.2

MEASUREMENT OF SIGNAL-TO-BACKGROUND NOISE RATIO IN SATELLITE TELEVISION CHANNEL WITH DISPERSION OF FM SIGNAL ENERGY

Moscow ELEKTROSVYAZ' in Russian No 5, May 83 (manuscript received 21 Sep 82)
pp 13-14

LOKSHIN, B.A., LISTOV, I.B. and NIKULIN, N.I.

[Abstract] Quality control of television transmission in the "Moskva" system via satellite relay and with narrow-band automatic frequency control requires regular signal measurement at the receiver stations. These measurements must take into account the presence of a residual FM dispersion signal, not quite eliminated by "tying" the level of the image signal through the d.c. restorer circuit in the video amplifier in the receiver bay. This residual dispersion signal appears after predistortion and the automatic frequency control subsequently reduces the frequency deviation, but it introduces a significant error (typically 10-18 mV) into the measurement of background interference (typically 7 mV). During measurement of the weighted noise (typically 1.5 mV) the 2.5 Hz dispersion signal is automatically suppressed by the interference suppression filter, but an additional filter is required for suppressing it during measurement of the background interference. A special filter for this purpose has been developed with 40 dB attenuation at 2.5 Hz, a printed-circuit active high-pass filter with transistor amplifier stage. Figures 2; references: 3 Russian.
[258-2415]

UDC 621.396.946.2

DESIGN OF RELAY CIRCUITS FOR PHASE-LOCKED AUTOMATIC FREQUENCY CONTROL IN SATELLITE COMMUNICATION SYSTEMS WITH MULTISTATION ACCESS AND TIME SHARING

Moscow ELEKTROSVYAZ' in Russian No 5, May 83 (manuscript received 25 Jan 83)
pp 9-13

SIMONOV, M.M. and PAN'KOV, G.Kh.

[Abstract] The design of a relay circuit for phase-locked automatic frequency control in satellite communication systems with multistation access and time sharing is analyzed, synchronization of ground stations being achieved by tying the time bases of all local stations to that of one master station. The performance of the phase detector in such an automatic control system is largely

affected by the time delay which the satellite transmission line inserts into the feedback loop. Calculations are based on a mathematical model of a phase detector which produces a signal determined by the sign of the error signal but carrying no information about the magnitude and the rate of change of the error signal. For solving the closed-loop equation, first the open loop differential equation describing the dependence of output signal on error signal is solved. This is done most expediently by reducing this equation to a system of two linear differential ones. The initial conditions for the steady-state process are not randomly selected but follow from the closed-loop equation. A periodic steady-state process in such a control system with relay characteristic consists of three stages per cycle, the second and third stage corresponding respectively to the negative and positive half-period of the error signal when readout is set to begin before the following cycle begins. For calculation of the transient process, the simultaneous solution of the aforementioned system of two equations continues beyond the first cycle till the results begin to repeat themselves. The design and review procedure is demonstrated on an astatic filter for phase-locked automatic frequency control. The results indicate that phase detectors with relay characteristic and oscillators with discrete phase control are suitable for multistation time-division satellite communication systems. Figures 2; tables 1; reference 4: 3 Russian, 1 Western (in translation). [258-2415]

UDC 538.574.4

ON HIGH FREQUENCY ELECTROMAGNETIC WAVE SCATTERING AT ELLIPTICAL IMPEDANCE
CYLINDER

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 26,
No 4, Apr 83 (manuscript received 22 Jun 82) pp 509-512

ZABORONKOVA, T.M., Scientific Research Radiophysics Institute

[Abstract] A cylindrical wave impinges from a vacuum on an unbounded elliptical cylinder having large electrical dimensions. The field scattered by the cylinder is represented as the sum of the field reflected in accordance with geometric optics and the diffraction field itself. The latter is represented in the form of the superimposition of the fields of the diffraction modes directed by the cylinder surface. Expressions are written for the field components of the individual diffraction modes. It is assumed that the radius of curvature of the directing surface and the cylinder impedance are slowly changing functions of one of the elliptical coordinates within the scale of the diffraction mode wave-length. Two specific forms of the impedance as a function of this elliptical angular coordinate are analyzed, which make it possible to ascertain particular features of the diffraction of electromagnetic waves at smooth objects. For lower values of the impedance, a rigorous solution is possible by the separation of variables, where the resulting formula describes the field of a quasi-surface wave throughout all space. For large values of the impedance, the quasi-surface wave becomes greatly compressed. The value of the impedance can be chosen so that the results of the quasi-optical approximation remain applicable to the quasi-static case. References: 4 Russian [255-8225]

UDC 551.510.535

PARAMETERS OF ARTIFICIAL INHOMOGENEITIES DETERMINED FROM BACKSCATTER OBSERVATIONS
USING OBLIQUE SOUNDING

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 26,
No 4, Apr 83 (manuscript received 3 Aug 82) pp 497-499

ALEBASTROV, V.A., BENEDIKTOV, Ye.A., IVANOV, V.N., IVANCHENKO, T.V., IGNAT'YEV, Yu.A., MUSHTAREYEV, O.M., SAVEL'YEV, S.M., SLIVINSKIY, A.P. and TEREKHOV, A.S.

[Abstract] Experiments to determine the fine structure of a region of the ionosphere based on backscatter signals were conducted during August and September of 1980 on a midlatitude path. The ionosphere was heated by means of a 150 KW

transmitter operating at 4.6 and 5.75 MHz, with an antenna directional gain of 100. The transmitter cycled with a CW transmission for 5 minutes followed by a 5 minute pause. The artificial ionospheric perturbation was observed at a point 1,300 km from the transmitter. The instrumentation measured the signal levels in the shortwave band for 10 different azimuths simultaneously. The overall viewing sector was 60° in azimuth. The sessions ran from 20:00 to 4:00 hrs Moscow time. The scattering cross-section in dB was measured as a function of frequency while observing the backscatter signal and this signal amplitude had reached the steady-state level, approximately one minute after the start of the heating. The scatter cross-section was practically constant during the observations and was independent of the heating frequency. The ultimate backscatter signal observation frequency followed the regular variations in the F_2 layer MUF (maximum usable frequency) in the region of the artificial inhomogeneity. However, it was 2 to 3 MHz higher than the F_2 MUF. The recording of backscatter signals using oblique sounding in an artificially heated region can be used to determine the parameters of small scale inhomogeneities which occur when high power radio waves act on the ionosphere and to select the optimal conditions for the study of the impact of artificial disturbances on ionospheric propagation. Figures 3; references: 3 Russian. [255-8225]

UDC 621.371

DETERMINATION OF ATTENUATION OF VISIBLE, INFRARED AND MILLIMETER WAVES IN CLOUDS USING METEOROLOGICAL MODELS

Moscow RADIOTEKHNIKA in Russian No 5, May 83 (manuscript received after completion 7 Jan 83) pp 21-27

BISYARIN, V.P.

[Abstract] The attenuation of radiation propagating through clouds is governed by the form of the distribution function of the particle size, the shape of the particles and their internal structure, the temperature and phase composition of the cloud, the overall refraction index of the particles and the water content or the concentration of the particles as well as their geometric dimensions. The statistics of these parameters are studied in order to substantiate meteorological models for stratus and cumulus clouds which make the greatest contribution to attenuation. Bulk attenuation factors are calculated using a one-time scattering approximation with the models adopted in this paper; the figures are compared with experimental data for visible and infrared wavelengths. An experimental check of the proposed procedure for estimating the overall attenuation is difficult in the visible and IR spectrum because of the considerable optical thicknesses and multiple scattering. Millimeter wavelength data are used to show that the model calculation for cumulus clouds is in good agreement with experiment, while the calculated attenuation in stratus is only of the same order of magnitude. The analysis of the experimental data on the size and water content of droplets shows that the clouds responsible for the greatest attenuation can be described by three microstructural models, where the water content is a linear function of the altitude above the base of the cloud. The per unit

length attenuation factors for visible (0.63 micrometer) and infrared (10.6 micrometer) wavelengths calculated from the models are in satisfactory agreement with the cloud attenuation data from aircraft and high mountain path measurements. Figures 3; tables 4; references 17: 13 Russian; 4 Western. [254-8225]

UDC 621.372.413-422.13

AXISYMMETRIC OSCILLATIONS IN SPHEROIDAL OPEN DIELECTRIC RESONATORS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 3 Apr 81) pp 864-870

STARKOV, M.A.

[Abstract] The problem of axisymmetric oscillation modes in spherical open dielectric resonators in free space is solved for an oblate ellipsoid of revolution. The spectrum of natural modes is determined from the characteristic equation and the condition of continuity for the tangential field components at the resonator surface, with expansion into oblate radial spheroidal functions of the first kind (inside) and of the fourth kind (outside). The results are compared with those for a sphere, a circular cylinder, and a plane-parallel layer as limiting figures into which an ellipsoid degenerates. A numerical solution has been obtained for the case of infinite dielectric permittivity, the result being usable, with sufficient accuracy, for practical cases of high finite dielectric permittivity. Figures 1; tables 1; references 10: Russian, 5 Western. [261-2415]

UDC 621.391.029.74

OPTIMIZED PROCESSING OF OPTICAL SIGNALS FOR NONCOHERENT DETECTION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 16 Feb 82) pp 931-942

BAKUT, P.A., LOGINOV, V.A. and MAYSTRENKO, G.I.

[Abstract] Direct or noncoherent detection of semicoherent optical signals is considered from the standpoint of the radar problem of maximizing the signal-to-noise ratio at the receiver output. The probing radiation is assumed to propagate as a light beam coherent in space and as a light pulse semicoherent in time, noncoherence in time being caused by longitudinal modes of optical radiation. Signal distortion in the atmosphere is taken into account, but amplitude fluctuations of the reflected field are assumed to be the same at all points of the receiver aperture so that the amplitude itself can be regarded as a nonrandom quantity. The signal-to-noise ratio at the receiver output is calculated for a receiver structure consisting of an inertialess phase detector preceded by an optical filter with a space filter behind and followed by a low-pass filter. The predetection amplification is also assumed to be a nonrandom

process, with negligible transients. The parameters of the receiver components and thus the processing of signals are optimized for a maximum signal-to-noise ratio, assuming external factors such as signal level and ambient noise as well as probing signal characteristics and distortions by the atmosphere to be fixed. The conditions for optimum space processing and for optimum time processing are established separately, the former achievable by means of a focusing lens and the latter achievable by matching the postdetection filter either with the modulus of the signal envelope (behind the optical filter) squared in the case of a perfectly coherent signal or with the convolution of that modulus squared and the pulse response of the high-frequency filter squared in the case of a strongly noncoherent signal. Optimality of the postdetection filter is not very critical, inasmuch as an appreciable decrease of the signal-to-noise ratio results only from a large mismatch between the passband of the predetection filter and the spectral width of the incoming signal or between the passband of the postdetection filter and the band of the video pulse behind the optical filter. Figures 1; tables 3; references 8: 7 Russian, 1 Western in translation. [261-2415]

UDC 621.391:519.2

CONCURRENT OPTIMIZATION OF TRANSMISSION AND RECEPTION CHANNELS IN RADAR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 22 May 81) pp 911-914

BUROV, V.A., DMITRIYEV, O.V. and TUYKIN, O.R.

[Abstract] Concurrent optimization of transmission and reception channels in a radar system is treated as a problem of selection of the signal to match two linear scattering operators. One operator (S) is sought in the algorithm of signal processing, the other one (R) is the interference operator. The optimum processing algorithm is constructed according to the likelihood-ratio criterion. The optimum signal is selected so that its vector will ensure the best distribution of the likelihood ratio (typically for maximum signal power at a fixed significance level on the basis of L-statistics). Signal selection is particularly important in the case of a small useful signal component at the receiver. A practical application of this method is the case of an a priori known scattering operator S. One can assume here an upper limit of signal power and a bounded norm of the signal vector space, also a Gaussian distribution of signal readings. The choice of signal will depend on the dominant interference mode and its correlation matrix. When the interference is an external noise, then the problem approaches the classical one of filter optimization for detection of a signal with known waveform. References 6: 5 Russian, 1 Western in translation. [261-2415]

EXPERIMENTAL STUDY OF SHORTWAVE SIGNAL SCATTERING BY A MOVING TERMINATOR

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 12 Jul 82) pp 499-502

GALUSHKO, V.G. and YAMPOL'SKIY, Yu.M., Institute of Radiophysics and Electronics of the UkSSR Academy of Sciences

[Abstract] The special case of multipath propagation where the field at the receiver is produced by two spatial components is analyzed. These components are the direct wave (usually, via a single skip path) and that reflected from the moving "night--day" boundary (the terminator). The transmitter was the RVM station of the State Time and Frequency Service located in Moscow and the signal was received at the radio astronomy observatory in the settlement of Grakova. The direct propagation path was approximately 640 km long. The "north-south" antenna system of the UTR-2 radiotelescope was used to receive the 9.996 MHz signals. The measurement technique did not allow a direct determination of the reflection factor of the terminator, because the field incident to the night--day boundary was not known; nonetheless, it is noted that the reflected signal level averages 10 to 15 dB lower than the direct nighttime signal, which confirms the conclusions that mirror reflection conditions are not met at the terminator and the recorded field is the result of wave scattering at electron concentration gradients and inhomogeneities in the transition region. The doppler shift of the reflected signal frequency is plotted as a function of observation time for the months of April and December, showing reasonable good agreement between theory and experiment. The most frequent reliable detection of the signal reflected from the terminator occurred at distances on the order of 1,500 to 2,000 km immediately before sunrise. This is apparently related to the change in the field incident on the terminator. Figures 3; references 7: 6 Russian; 1 Western in translation. [255-8225]

ON APPLICATION OF MONTE CARLO METHOD TO SOLUTION OF STATISTICAL RADIO WAVE PROPAGATION PROBLEMS IN RANDOMLY INHOMOGENEOUS IONOSPHERE

Moscow RADIOTEKHNIKA in Russian No 5, May 83 (manuscript received after completion 29 Dec 82) pp 64-67

KOPEYKIN, V.V., SOKOLOVSKIY, V.I. and CHERKASHIN, Yu.N.

[Abstract] Because the stochastic equation describing radio wave propagation in a randomly inhomogeneous ionosphere, given the condition of slow fluctuations in the properties of the medium and a monochromatic source, do not have a precise analytical solution, the Monte Carlo technique is used to estimate the statistical characteristics of the wave field described by this equation.

The solution of the stochastic equation is reduced to the dynamics problem of numerically calculating the wave fields for a finite number of media. The set of properties of the random quantity are estimated from a limited sample whose volume governs the precision of the estimates. The solution of the statistical wave problem is broken down into three steps: 1) Generation of the realizations of the random medium; 2) Numerical calculation of the wave field; and 3) Estimation of the statistical characteristics of the field parameters. A parabolic equation technique from diffraction theory as well as a variant of it, the so-called beam method, are used in the calculation of the wave field. The impact of random inhomogeneities in the ionospheric electron concentration on the radio wave field intensity in the region of the caustic curve is evaluated; the amplitudes of short waves at the earth were calculated for the case of propagation through a single layer model of the ionosphere with normal, Poisson and wave-type random fluctuations. The calculations were carried out for a frequency of 15 MHz and it is shown that the regular structure of the field is destroyed in the region of the caustic with relative fluctuations in the random component on the order of 1 percent. The Monte Carlo calculations are in qualitative agreement with experimental data published previously in Soviet literature. Figures 6; references: 3 Russian. [254-8225]

UDC 621.396.67

SELECTING OPTIMAL GEOMETRIC PARAMETERS FOR HELICAL CONICAL ANTENNAS USING WIRE WITH ADDITIONAL BENDS

Moscow RADIOTEKHNIKA in Russian No 5, May 83 (manuscript received 17 Nov 82)
pp 62-64

DEMIDCHIK, V.I.

[Abstract] A conical log-spiral antenna is made from a wire which has sharp angular bends in it in order to produce the log periodic meander as the wire is helically wrapped around the expanding cone. The additional bends create an increased internal interactive delay and it is possible to numerically determine the properties of such radiators based on the amplitude-phase distribution of the current found from a solution of the integral equation for thin conductors. This paper employs a piecewise constant approximation of the desired current distribution function based on a solution of Pocklington's integral equation to find the optimal geometric parameters of such double equal angle conical helical antennas. The minimum and maximum values of the electrical radius of the region of axial radiation were determined as a function of the geometric parameters of the antennas. The number of entry turns in the spiral should be no less than four and the particular angular dimensions are given. This optimization makes it possible to reduce the antenna dimensions by a factor of about 1.5 times. The author is grateful to A.V. Runov for helpful discussions of the material in the paper and thanks N.V. Kalashnikov for assistance during computations. Figures 3; references 4: 2 Russian, 1 Western. [254-8225]

CHANGES IN THE DIRECTION FINDING CHARACTERISTICS DURING TRACKING OF SOURCE OF SIGNAL WITH MISMATCHED POLARIZATION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian No 5, May 83 (manuscript received 13 Sep 79, after correction 15 Aug 82) pp 894-899

SERGIYEVSKIY, B.D.

[Abstract] The performance of a direction finder is analyzed for the case where the polarization of incoming signals differs from the polarization of the receiver antenna. The radiation pattern of a receiver antenna in the general case of arbitrary signal polarization is characterized by the polarization matching factor as a function of the angular coordinate. The direction finding characteristic of an amplitudinal monopulse goniometric coordinator with sum and difference channels is calculated in these terms, its slope depending on the polarization mismatch and being either increased or decreased by an additive extra term which can be positive or negative. The angular error and the functional limit of the goniometer are determined by this term, as shown specifically in the case of a parabolic antenna with linear operating polarization. With the antenna polarization in a plane typically at 45° to the principal axis, the slope of the goniometer characteristic becomes negative and the accuracy of source tracking becomes unacceptably low as the direction of signal source polarization approaches the direction of cross-polarization. Theoretical calculations and experimental data yield an approximately $\pm 5^\circ$ instability sector. Figures 4; references 19: 10 Russian, 7 Western (3 in translation). [261-2415]

COST OPTIMIZATION OF ANTENNA DIMENSIONS FOR SPACE SOLAR ELECTRIC POWER PLANT

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 16 Apr 81) pp 977-983

VASIL'YEV, A.V., KLASSEN, V.I., LASKIN, N.N. and TOBOLEV, A.K.

[Abstract] The problem of optimizing antennas for space solar electric power plants is formulated with respect to the cost of 1 kW electric output power. With the specific field amplitude-phase distribution in the aperture of the transmitter antenna assumed to be given, the characteristic dimensions L_t of the transmitter antenna and L_r of the receiver antenna (on ground) are to be determined which will minimize the cost function first in the case of a constant power input to the transmitter antenna and then for a power input to the transmitter antenna proportional to the aperture area of that antenna. For both a linear transmitter antenna array and a square transmitter antenna array the respectively two-dimensional or three-dimensional problem reduces to a system of corresponding two transcendental equations with the cost of 1 kW as a function of L_t ($L_r = L_{r,opt}$ fixed) having a minimum in the case of constant

input power and having no extremum but decreasing monotonically as L_t increases in the case of proportional input power. Calculations for a specific solar electric power plant in a geostationary orbit at radius $R \sim 36,000$ km have yielded $L_{r, \text{opt}} \approx 5730$ m and $L_{t, \text{opt}} \approx 630$ m or an 83:1 ratio of respective aperture areas. Figures 4; references 11: 6 Russian, 5 Western (2 in translation)
[261-2415]

UDC 621.396.96:621.391.26

ESTIMATE OF STEADY-STATE INTERFERENCE COVARIATION MATRIX

Moscow RADIOTEKHNIKA in Russian No 5, May 83 (manuscript received 16 Nov 82)
pp 53-55

LIFANOV, Ye.I. and LIKHAREV, V.A.

[Abstract] The optimal N-dimensional complex vector of the weighting function in adaptive antenna arrays and moving target indication (MTI) systems is determined as a function of the signal properties and the a priori information on it in terms of the Hermitian covariation matrices of the interference, the estimates of these matrices, the estimate of the $(N - 1)$ -dimensional covariation vector of the interference, the Hermitian covariation matrix of the signal, the maximum eigenvalue of the matrices and the N-dimensional complex signal vector. The maximum likelihood estimate equation usually employed as the estimate of the covariation interference matrix is adduced and is assumed to be a greenhouse covariation matrix in this paper for two cases: 1) In adaptive MTI systems exposed to interference which is steady-state in the estimation range, given the condition that the samples of the observed process are taken at equal time intervals; and 2) In adaptive linear antenna arrays with equal spacing between the array elements. The estimate of the maximum likelihood of the greenhouse covariation interference matrix is found which permits boosting the effectiveness of MTI systems for a constant repetition rate of the probe signal in these latter linear antenna arrays. The impact of the estimate convergence rate on the efficiency of an adaptive bandstop filter which minimizes the mean square error is also briefly evaluated. The use of the proposed estimate of the maximum likelihood of the covariation matrix makes it possible to substantially increase the adaptation speed of MTI systems and antenna arrays, thereby improving their effectiveness with a small teaching sample volume. Figures 2; references 3: 1 Russian; 2 Western (1 in translation)
[254-8225]

DIAGNOSIS OF FAULTY ELEMENTS IN PHASED ANTENNA ARRAYS BY FOCUSING METHOD

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 25 Feb 82) pp 843-853

KINBER, B.Ye., ANYUTIN, A.P. and MARTYNOV, A.M.

[Abstract] The method of "focusing convolution" for diagnosis of faulty elements in phased antenna arrays on the basis of the current distribution involves measurement of the field at some distance from the antenna and producing its image by convolution of its structure and the focal spot. The distance from the plane of the antenna to the plane of measurement must be correct, relative to the antenna dimensions, for the necessary resolution and for revealing the vector nature of the field. The integral equation of the first kind for diagnosis is formulated so as to relate an arbitrary distribution of currents $I(x, y, 0)$ in the $z = 0$ plane of a two-dimensional antenna array to the field $E(\xi, \eta, z_0)$, $H(\xi, \eta, z_0)$ these currents produce in the $z = z_0$ plane of measurement. This equation is solved approximately through convolution of the field E, H and a scalar exponential function. The resolution is then calculated, considering that the ultimately attainable resolution is of the order of $1/2\lambda$ with the Fourier transforms of the focusing matrix components being finite functions. The cross-polarization in the focal plane is established and a higher resolution is found to be achievable by increasing the collimator surface area with small values of the weight function around its periphery. The effect of discretization on the accuracy and the economy of measurements is determined. The minimum distance from the antenna, preferable from that standpoint, is limited by antenna reaction in the plane of measurement as well as by interaction of the antenna with the measuring probe. For attainment of a given high resolution, it is found necessary to decrease the discretization step in measurements near the antenna but it is permissible to increase the discretization step with increasing distance far from the antenna. Least expedient are measurements made within the intermediate zone between the near field and the Fraunhofer region. Figures 7; references 5: 4 Russian, 1 Western in translation. [261-2415]

OPTIMIZATION OF ANTENNA RADIATION PATTERN UNDER CONDITIONS OF SPACE INTERFERENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 10 Feb 82) pp 995-998

SENIN, A.G.

[Abstract] The problem of synthesizing an antenna radiation pattern and optimizing it for maximum signal-to-noise ratio under conditions of interference within discrete definite space sectors, as found in radio astronomy, is solved on the basis of the solution to a similar problem for a harmonic signal and

arbitrary N discrete directions of interference. The optimum space-time filter is obtained by replacing the summation with a definite integral and aiming at an infinitesimal intensity of interference from a given direction. The filter function and the weight function are calculated by reduction of the corresponding system of integral equations to a system of four algebraic-trigonometric relations between coefficients and numerical evaluation of the latter. The characteristic equation of such a filter indicates the feasibility of separate space and time processing. The method is illustrated with a typical numerical example of a linear antenna of relative length $L/\lambda = 80$ receiving a signal at angle $\varphi = 10^\circ$ with interference within the $11^\circ \leq \theta \leq 13^\circ$ sector. Figures 2; references: 2 Russian.
[261-2415]

WAVES IN SCALE-INVARIANT SYSTEMS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 7 Apr 82, after completion 15 Sep 82) pp 415-421

KUZNETSOV, A.P., KUZNETSOV, S.P., MEL'NIKOV, L.A., OSIN, A.B. and ROZHNEV, A.G., Saratov State University

[Abstract] Translational invariant systems are those in which a system is congruent with itself when shifted through one period (periodic systems) or shifted by any amount (homogeneous systems), or when rotationally shifted (helical). Those systems which are congruent with themselves with a change in all dimensions (scales) by some factor of "a" times are called scale-invariant. For scale invariant systems with discrete values of "a," the smallest possible value of "a" other than unity is called the scale factor and written in terms of "b," where $a = b^n$, n being an integer. Such systems include log-periodic and frequency independent antennas with ultrawide bandwidths (10:1 and more). This paper analyzes the physical picture of wave phenomena in scale-invariant systems, which is similar in essence to that found in homogeneous and periodic systems (e.g., the concepts of a dispersion equation, spatial harmonics, group and phase velocity, synchronism). A general wave equation is derived in integral form for the free waves in scale-invariant systems. There is no dispersion equation for these systems, because the symmetry operators are not commutative. The form of the eigenfunctions of scale-invariant systems is found and the nucleus of the integral wave equation is related to the relevant eigenfunctions. There is a relationship between the longitudinal structure of the eigenfunction and the dispersion of the generating system; an explicit form of this relationship is found for nearly homogeneous systems. The next logical step in the extension of the theory should be the analysis of wave excitation and the solution of the problem of wave interaction in scale-invariant systems. Figures 4; references 6: 4 Russian; 2 Western. [255-8225]

STUDY OF OPEN RESONATORS WITH RECTANGULAR INHOMOGENEITIES IN THE REFLECTOR

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 9 Dec 81, after revision 2 Nov 82) pp 447-454

BULGAKOV, B.M., SKRESANOV, V.N. and FISUN, A.I., Institute of Radiophysics and Electronics of the UkSSR Academy of Sciences.

[Abstract] An open resonator made with two reflectors, one of which is spherical with an energy output coupling slot and the other flat, having a rectangular notch cut in it to a depth h , with a width b and a length l , is studied in order to determine the Q as a function of the notch dimensions. The spherical reflector has a radius of curvature of 150 mm and an aperture of 85 mm. The flat reflector is designed so that the groove dimensions can be varied over a wide range, with three basic different cross-sections. The loaded Q was determined based on the half-width of the resonance curve observed with a spectrum analyzer in the 8 mm band, where the klystron was frequency modulated with a sawtooth waveform. The three configurations were: 1) An open resonator with a rectangular notch of unlimited length; 2) An open resonator with inhomogeneities in the rectangular notch; and 3) An open resonator with a rectangular step projection. Good agreement is noted between the measured Q expressed as a function of the groove dimensions in the flat reflector and that calculated from the solution of the problem of H-polarized wave diffraction at a plane having the same notch. Inhomogeneities in the notch excite an electromagnetic wave which propagates along it, sharply reducing the resonator Q . With the appropriate placement of several inhomogeneities, the excitation of such waves can be avoided and the efficient functioning of local structures in an open resonator can be assured. In these resonators, two resonance conditions should be met simultaneously; this is accomplished by choosing the spacing between the reflectors and the height of the extended inhomogeneities. This makes it possible to have a tunable open resonator with efficient filtering of longitudinal modes. Figures 7; references: 7 Russian.
[255-8225]

UDC 621.372.8.029.7

INTEGRATED OPTICS - STATUS AND PROSPECTS FOR DEVELOPMENT

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 4-9

GONCHARENKO, A.M.

[Abstract] Integrated optics involves the generation, propagation, control, transformation and detection of light waves in thin film waveguides, with the practical purpose of creating new optical devices similar in their functional characteristics to electronic integrated circuits based on semiconductors. The photon is the information carrier in integrated optics, which, in comparison

with electronic circuits, has certain advantages such as higher speed, wider bandwidth of transmission and more noise tolerance. This article discusses the current status of scientific research in the area of integrated optics and elements which have been developed. Problems and prospects are briefly noted. The possibility is mentioned of the creation of monolithic hybrid circuits in which integrated optic elements are created from various materials on a single substrate by planar technologies. It is thought that the replacement of much existing optical technology and some electronic circuits with integrated optical devices will open new possibilities for science and technology, particularly the creation of a single system of television communications including video telephone. Figures 3; references 32: 16 Russian, 10 Western, 4 in translation) [264-6508]

UDC 621.372.51

DESIGN OF SWITCHABLE FILTERS FOR WIDEBAND TRANSMITTERS

Moscow ELEKTROSVYAZ' in Russian No 5, May 83 (manuscript received 4 Aug 81)
pp 21-25

BAYEVSKIY, V.Yu. and KOZYREV, V.B.

[Abstract] Use of switchable rather than tunable filters for suppression of higher harmonics in the load of wideband transmitters eliminates the need for manual or automatic matched adjustment of multicomponent resonance circuits. The output capacitance of electron devices can be assumed not to limit the bandwidth of such filters. This applies to 30-60 MHz transistor oscillators and to transistor oscillators with matched compensation in the collector circuit for operation at frequencies above 60 MHz, as well as to tube oscillators with distributed gain and output capacitance in the plate circuit. In the latter case a filter which is also a plate load has the tube output capacitance as its first element. Elliptical low-pass Cauer filters or "equal ripple" Chebyshev polynomial filters are preferable to bandpass filters in terms of size and weight minimization. The number of filters as well as their frequency-span ratio and upper cutoff frequencies are determined by the transmitter frequency-span ratio. The subsequent design procedure involves synthesis of an equivalent driving low-frequency oscillator with attenuation characteristics and internal resistance corresponding to the limiting performance characteristics of the high-frequency oscillator. Elements of the filter circuit and the number of filter sections are selected according to standard procedure, with use of normalized frequency and loss tables. The performance of the prototype is calculated and the design is then refined, most expediently on a computer. Typical numerical calculations for a seventh-order low-pass Cauer filter indicate that maximum current (voltage) as well as maximum reactive energy and power loss in inductive and capacitive elements occur near the filter cutoff frequency and can differ appreciably from one element to another. These reactive elements must be selected on this basis and so that their Q-factor will be maximum at the filter cutoff frequency. It is not necessary to tune such a filter in the

case of small power level fluctuations, but the output signal frequency must not exceed the filter cutoff frequency lest the high-frequency oscillator cease to operate properly and filter coils or capacitors overheat and break down. Figures 3; tables 2; references 11: 9 Russian, 2 Western (both in translation). [258-2415]

UDC 621.372.54.029.6

ACTIVE MICROWAVE FILTERS ON BASIS OF TRANSISTOR-TYPE IMMITTANCE TRANSFORMER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 22 Jan 80, after correction 21 Dec 81) pp 817-833

FILINYUK, N.A.

[Abstract] The main advantages of active microwave filters are a lossless pass-band and a Q-factor (relative bandwidth), independent of the geometrical dimensions. One basic version of such filters includes a semiconductor device (diode or transistor) with negative dynamic resistance, inserted into a passive circuit. The problem here is that tunnel diodes have a low saturation level and IMPATT diodes have a high noise level, while transistors have a limited frequency range. The other, preferable, basic version is a generalized imittance transformer using transistors and not requiring inductive components. The performance of microwave imittance transformers is analyzed on the basis of physical processes such as motion of charge carriers and their spacetime kinetics, as well as the resulting current-voltage and impedance-frequency characteristics. Imittance transformation is described in terms of equivalent RLC networks and an appropriate common-emitter or common-base transistor circuit. Either bipolar or field-effect transistors are suitable for this application. The design of band-pass and band-stop filters can be optimized, with the aid of testing, for their amplitude-frequency characteristic to suit specific requirements, for temperature stability of their power-dependent parameters by means of passive elements, for a noise factor (which is higher than in passive filters), and for stability margin by means of a large equivalent-generator conductance or by transformer circuit selection. Noise factor and sensitivity are evaluated by standard methods, so that the former then decreased and the latter increased by proper choice of components. Tuning of an active filter without loss of stability is possible by controlling its quasi-resonance frequency, the attenuation coefficient at that frequency, the absolute bandwidth, or relative bandwidth (Q-factor) with a control signal, while changing the other fixed filter parameters minimally or as much as is permissible. Imittance transformers can be staged for increasing the bandwidth. Transistors such as 2N3866 or KT3101/371/913 have been used in single-stage and two-stage imittance transformers for reciprocal and nonreciprocal active filters. Band-pass filters of this kind can, in turn, be used for microwave delay lines, lossless ones or with signal amplification. Figures 9; references 40: 20 Russian, 20 Western (4 in translation) [261-2415]

NONLINEAR ANALYSIS OF PHASE-SHIFT (C-PARALLEL) RC-OSCILLATORS AND OSCILLATOR WITH DISTRIBUTED RC-NETWORK

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 8 Apr 81) pp 948-954

VOROB'YEV, A.M. and YELISEYEV, V.O.

[Abstract] Phase-shift oscillators are analyzed rigorously on the basis of a nonlinear theory. The corresponding nonlinear partial differential equations are solved for the steady state with a small self-excitation margin, without restriction on the nonlinearity of the active element. The system of equations is formulated first for an oscillator with three RC-stages and then for one with n RC-stages. The solution is sought in the form of an integral-power series in the square root of the small Poincare-Rayleigh-Lyapunov parameter. The performance parameters, namely output voltage and ripple factors as well as amplitude of the third harmonic, are calculated after explication of the indeterminacy and subsequent permissible simplifications. The results are extended to the limiting case of an oscillator with a distributed phase shifting RC-network. Results of approximate numerical solution have been verified experimentally with an oscillator containing a K140UD1B operational amplifier as active element, two KP103M field-effect transistors on the input side providing a high input impedance, and 3-10 RC-stages or a distributed RC-network on the output side for phase shifting. The ripple factor increases consistently with increasing number of RC-stages. Figures 2; tables 2; references: 8 Russian. [261-2415]

SYNTHESIS OF REGENERATIVE MICROWAVE POWER AMPLIFIERS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 6 Apr 81) pp 943-947

BUGAYEV, A.V., IZHKO, N.S. and RAVVA, D.P.

[Abstract] Both reflection-type and transmission-type regenerative nonlinear microwave power amplifiers are synthesized for given amplitude-frequency characteristics. The regenerative element consists of a frequency-independent amplitude-dependent negative conductance g ($dg/dA < 0$) and a susceptance B with small-signal Q -factor and amplitude-dependent resonance frequency ω ($d\omega/dA < 0$) in parallel (normalized signal amplitude $0 \leq A \leq 1$) with an n -stage coupling network in the form of a band-pass ladder. The parameters of the coupling network are calculated from equivalent-circuit relations and then optimized for maximum power transfer with wideband matching so as to yield a Chebyshev or maximally flat amplitude-frequency characteristic of the amplifier with all linear circuit components tuned to the center frequency. Figures 2; references 7: 6 Russian, 1 Western (in translation). [261-2415]

DIGITAL COMPUTER MODELING OF COMBINED DETECTION AND FILTERING CIRCUITS

Moscow RADIOTEKHNIKA in Russian No 5, May 83 (manuscript received after completion 10 Dec 82) pp 51-53

YENDOVITSKAYA, L.G.

[Abstract] A signal is modeled with a conditional Poisson field in terms of the Poisson field intensity and a Markov process. A recurrence algorithm for the combined detection and filtering of random Poisson fields is constructed which permits the analysis of such combined detection and filtering systems on digital computers. The analysis uses the example of a Poisson field typical of the problem encountered in the detection of an optical signal propagating in a turbulent atmosphere. The recurrence algorithm for the i -th step is given along with analytical expressions for the false alarm and detection probabilities. Estimates of the intensity of a Poisson signal field are shown graphically for a displacement of the position of the signal intensity maximum relative to the observation point by 1, 4 and 6 cm for a ratio of the maximum intensity of the Poisson signal field to the noise field of 2 and a random process correlation time of 10^{-5} sec. The error probabilities ($P_{err} = (1/2)[P_{false\ alarm} + P_{detect}]$) were 0.09, 0.099 and 0.113 respectively. Figures 3; references 4: 3 Russian, 1 Western in translation.
[254-8225]

UDC: 535.853

ONE ALGORITHM FOR ESTIMATING SPECTRAL DENSITY PARAMETERS OF RANDOM SIGNAL

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 3, Mar 83 (manuscript received 16 Apr 81; after completion 1 Sep 81) pp 118-120

ZOTOV, MIKHAIL GRIGOR'YEVICH, doctor of technical sciences, Moscow Institute of Electrical Machine Building

[Abstract] An algorithm is presented for estimating the parameters of spectral density of a random signal, assuming that the spectral density is described by a fractionally rational expression. After some time of observation of the random signal, the coefficients of the fractionally rational function must be estimated. A new and less cumbersome algorithm for parameter estimation is presented in this article, by selecting the fractionally rational function so that the integrand in the equation for estimation always has a numerator, the power of which is at least two less than the power of the denominator. The main difference of this algorithm from that presented in an earlier work is that the parameters are determined without the requirement of solving a nonlinear equation system, greatly simplifying the identification algorithm. References: 4 Russian. [239-6508]

UDC 537.86:519+621.391.82

MATHEMATICAL MODELS OF PULSED NOISE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 1 Jul 82) pp 68-73

PROTSENKO, L.D.

[Abstract] Pulsed noise influences the reception of signals, in many systems. Known pulsed noise models include the Hall model plus certain others in which the distribution is varied for a more precise approximation of experimental distributions of pulsed noise amplitude and length, plus a second group of pulsed noise models in which the spectral density is constant in the reception band. These models unsatisfactorily analyze the method of analysis of the response of linear and nonlinear systems to their effects. This work suggests that nonlinear pulsed random processes and linear summary random processes based upon random processes with independent increments be used as such models. The practical

significance of the pulsed noise models suggested is primarily that their full probabilistic description creates the necessary foundation for the development of optimal methods of detection of signals against their background, as well as for evaluation of the noise stability of the communications or radar system operating with pulsed noise present. These models can be used to solve applied problems of pulsed noise transformation in nonlinear systems. References 9: 8 Russian, 1 Western.
[237-6508]

UDC 621.317.373:519.213

PROBABILISTIC RADIO SIGNAL PHASE MODELS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 6 Apr 82) pp 73-79

ATAYANTS, B.A. and KARPOV, A.V.

[Abstract] A study is made of a narrow band normal random radio signal in the form of the sum of two components: a stable (deterministic) component and a normally fluctuating component, each with the different dispersion. The complexity of the analytic expressions for the distribution function and numerical phase characteristics of a narrow band normally fluctuating signal not only make it difficult to apply them in practice, but also to prevent complete investigation of the specifics of the density. Equations are derived relating the parameters of the distribution, and an estimate is made of the relationship of the probabilistic models based on the Kolmogorov Agreement criteria. The calculated variation of the criterion as a function of parameter "a" for various versions of the function $b=f(a)$ are presented in a figure, which also shows curves representing the accuracy of approximation of the asymptotic values of the solution equations. The results of computation indicate that the statistical model of the phase of the fluctuating radio signal suggested greatly simplifies the analytic recording of the theoretically produced distribution and reproduces its characteristics in full volume and with high accuracy. Figures 5; references: 3 Russian.
[237-6508]

UDC 621.372.852.1

MICROWAVE EQUIPMENT OF 'RADAN-2' DIGITAL RADIO RELAY SYSTEM

Moscow ELEKTROSVYAZ' in Russian No 5, May 83 (manuscript received 30 Nov 82) pp 32-34

MARTYNOV, L.M., PEREGONOV, S.A. and CHERNYY, V.E.

[Abstract] The modern version of the "Randan" radio relay system with IKM-15 pulse-code-modulation equipment features a transmission rate as high as 1024 kbit/s with a correspondingly small frequency deviation of FM signals. The postdetection video regenerators and the regenerators for automatic distortion

correction have been redesigned, and the remote power supply has been moved into the terminal station. The length of the connecting cable can be varied from 0 to 4 km so that tall buildings and water towers can be used instead of expensive transmission poles. The main objective in redesigning the microwave equipment for "Radan-2" was miniaturization, especially of the transceiver, with retention or even improvement of the electrical characteristics and with provisions for easy replacement of even the least reliable defective active components. The transceiver includes components which determine its output characteristics, voltage level and frequency stability, as well as auxiliary components which do not determine its output characteristics but ensure its proper operation. Ferrite diodes and a directional coupler in the latter category, as well as the detector stages in the frequency stabilization loop and the balancing mixer, have all been built on microstrip lines in a single hermetically sealed module. The directional coupler and the duplexer in the transmitter, also the transmitter input and output filters, have been built on waveguides either completely filled with dielectric or cutoff waveguides with discontinuities in the filler. Miniaturization has been achieved, moreover, by combining the stripline technology with hybrid integration. Figures 4; references: 8 Russian.
[258-2415]

UDC 621.376.56

USE OF REDUNDANCY IN LINE CODE FOR SERVICE COMMUNICATION IN DIGITAL TRANSMISSION SYSTEM

Moscow ELEKTROSVYAZ' in Russian No 5, May 83 (manuscript received 6 Apr 81)
pp 38-41

PTICHNIKOV, M.M., POLYAK, L.M. and SAVCHENKOV, Yu.P.

[Abstract] Use of code redundancy for service communication in digital transmission systems eliminates the need for either installing auxiliary circuits with attendant increased complexity of intermediate stations, or for having a four-conductor analog or digital channel with lower system throughput capacity. Such redundancy is generated by conversion of a binary signal to a quasi-ternary or other multilevel line signal with the number of possible combinations of symbols becoming larger than the number needed for data transmission. Exclusion of certain combinations facilitates passage of the line signal through line repeaters. Transmission of a reserve code combination (RCC) and of some original code combination (OCC) corresponds to transmission of a "1" and a "0", respectively, without a decrease of the throughput capacity of the digital group channel and without complication of the line channel equipment. The equipment on the transmitter side includes an analog-to-digital converter for encoding analog service information and controlling the reserve code combination, as well as an OCC detector, an RCC input device and a switch. The equipment on the receiver side includes an OCC detector, an RCC detector, an RCC-to-OCC changer, and a digital-to-analog converter for decoding the service information. Analog-to-digital conversion is performed by the pulse-code-modulation method or, for high transmission quality, by the linear delta modulation method. A four-symbol combination produced by formation of a quasiternary line signal in the place of four

zeros in the original binary signal has been found to be convenient for conversation to a reserve code combination. Such a service communication system is economical and relatively simple. Figures 6; tables 1; references: 9 Russian.

[258-2415]

UDC 621.382.001

STABILITY OF A GUNN DIODE OSCILLATOR IN LIMITED SPACE CHARGE STORAGE MODE

Moscow RADIOTEKHNIKA in Russian No 5, May 83 (manuscript received 22 Mar 82)
pp 39-41

DOKTOREVICH, M.M. and SHINKARENKO, V.G.

[Abstract] The analysis of Gunn oscillator stability in a limited space charge storage mode usually reduces to determination of the conditions for stability of the homogeneous field distribution in the diode. This paper considers this mode, taking into account the conditions both in the microwave circuitry and the power supply. An increase in the internal resistance of the power supply (which can ultimately be a current generator) leads to a substantial reduction in the stability range as compared to the range where the charge storage mode exists. A truncated equation for the oscillation amplitude is obtained through a Van-der-Pol solution of the generator equation of motion, from which the stability conditions are derived. When a source with a small internal resistance is used, low-frequency fluctuations in the diode current have no substantial impact on the stability. When this resistance rises, the interrelated process of the conversion of the low-frequency fluctuations upward to the range of the oscillating frequency and the down conversion of the high-frequency fluctuations in the oscillator circuit which occurs because of the nonlinearity of the volt-ampere characteristic, are responsible for this curtailed stability range. For diodes with a large positive slope of the volt-ampere characteristic, the range of stability in the region of strong fields proves to be limited both at the top and bottom ends of the range. Figures 3; references 9: 5 Russian; 3 Western (1 in translation).

[254-8225]

UDC 621.383.826:621.396

DESIGN OF FIBER OPTICS DATA ACQUISITION NETWORK

Moscow RADIOTEKHNIKA in Russian No 5, May 83 (manuscript received 14 Dec 82)
pp 67-71

KUTAKHOV, V.P., KHATIN, G.A. and YAREMCHUK, V.A.

[Abstract] The replacement of electrical communications lines with fiber optics necessitates the use of transducers for the electrical to optical conversion at the start of the line and the back conversion at its output. There are two types

of optical sensors: 1) Active which generate the optical signal as a function of the measured parameter; and 2) Passive which modulate an external optical signal. This paper studies the possibility of creating a data acquisition network using optical linear acceleration sensors which employ the phenomenon of a change in the light transmittance of the optical fiber when it is bent. The configuration of the proposed sensor allows light from a source to come through an optical directional coupler into the fiber optics light guide, where it is reflected from the mirror end face and then through the coupler to the photodetector. The free end of the light guide is loaded with a physical weight, whose mass along with the length of the free end and the rigidity of the light guide determine the range of accelerations which can be measured. A data acquisition network design is proposed using such sensors and it is noted that the use of such direct conversion transducers allows for maximum utilization of the advantages of fiber optics. The transmittance of the sensor is plotted as a function of the acceleration for various weight loads and indices of refraction of the fiber optics core and jacket. Figures 6: References: 2 Western (1 in translation).
[254-8225]

UDC 621.391

NOISE TOLERANCE OF INFORMATION TRANSMISSION SYSTEMS USING PULSE CODE MODULATION (A REVIEW)

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 27 Oct 82) pp 4-14

PILIPCHUK, N.I.

[Abstract] The many works on the use of pulse code modulation methods such as adaptive pulse code modulation, delta modulation and differential pulse code modulation reveal two approaches to computation of noise tolerance: 1) Sequential calculation, i.e., calculation by parts; and 2) Calculation of the noise tolerance of the system as a whole. In the first approach the statistical characteristics of the analog-digital converter were calculated, followed by the statistical characteristics of transmission error and finally, the characteristics of the entire system, in each stage utilizing the results from the prior calculations. In the second approach the approximation error is found considering the set of factors introducing changes to the message, including information source noise, noise in the communications channel, analog-digital conversion error and transmission delay. In the first case in constructing a system model some idealization is introduced but in stating the problem the conditions are precisely described and so-called "precise" calculations are performed. In the second case the models studied are usually closer to those used in practice but a number of serious simplifying assumptions are made in the calculation, making calculations more approximate. The first approach is characteristic for theoretical work, the second for applied work. Each approach has its advantages and disadvantages. This review describes works of the past 10 years, though it includes some earlier works which were fundamental in their introduction of ideas which were further developed in later works. References: 73 Russian.
[237-6508]

DESIGN OF ADAPTIVE DIGITAL TRANSMISSION SYSTEMS FOR CONTINUOUS MESSAGES BASED ON COMPRESSED DATA NOISE TOLERANCE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 27 Oct 82) pp 28-33

YAVORSKIY, Ye.A.

[Abstract] In multichannel digital transmission systems carrying continuous messages such as information measurement systems, a data compression algorithm is used with single parameter adaptation referred to as an aperture algorithm. However, the pulse-code modulation gain is difficult to calculate because of the complexity of analysis of the data compression algorithm, particularly in unsteady messages and other factors. In this article it is considered that the transmitted messages are centered gaussian random processes with known correlation functions. The unsteadiness of each message is described by the variation of one of the parameters of the correlation function with time. Assuming a balanced binary channel without memory, equations are derived which can be used to estimate the parameters of the optimal data compression frame structure from the standpoint of minimum mean signal power. An example is presented indicating that the equations produced are sufficient for engineering design of optimal systems with aperture data compression algorithms and computation of the problem of the expediency of their application by comparison with PCM. Tables 2; references 5: 4 Russian, 1 Western in translation. [237-6508]

OPTIMAL CONTROL OF RADIO SIGNAL POWER IN CHANNELS WITH FADEOUT AND FLUCTUATION INTERFERENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 16 Apr 81) pp 906-910

SHAROV, A.N. and GROSHIKOV, Ye.N.

[Abstract] A closed-loop stochastic control for the power of a radio signal in a channel with fadeout is synthesized according to the Bellman optimality principle, assuming the signal to be mixed with additive fluctuation interference of quasi-uniform spectral density. The control, acting at discrete instants of time, ensures minimization of a quadratic functional which characterizes the quality of signal transmission and the cost of control. The algorithm of this optimal control is based on treating the power fluctuation approximately as a quasi-stationary normal random process with given mathematical expectation and correlation function so that its dynamics can be described by the linear differential equations $\dot{y}_s(t) = Ay_s(t) + Cu(t) + Bw(t)$ (y_s - radio signal, u_s - deterministic control signal, w - normal white noise with zero mean value, t - time). This equation is converted to a discrete one $y_s(k+1) = \Phi y_s(k) + \psi u(k) + \Gamma w(k)$,

$k = 0, 1, 2, \dots$. The algorithm is formulated in terms of a recurrence relation suitable for adaptive control. An evaluation of its efficiency reveals that the latter depends largely on the accuracy of tracking the discretized signal process, the quality of control depends largely on the rate and the dynamic range of power fluctuation, and that adaptation here is a fast process completed within 3-8 steps. Figures 3; references: 6 Russian. [261-2415]

UDC 621.391.1

ANALYSIS OF THRESHOLD EFFECTS IN RANDOM SIGNAL SOURCE LOCATION ESTIMATION

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 12 Apr 82) pp 48-54

TRIFONOV, A.P., FEDOROV, V.I. and SHARAPOV, S.I.

[Abstract] Earlier works have estimated the location of the source of a random signal based on the method of maximum likelihood. However, the practical value of the method of maximum likelihood is greatly reduced in the case of short observation times and high noise levels. Therefore, the authors study the maximum likelihood estimate of the location of the source of a random signal, considering threshold effects. The narrow band gaussian signal is considered to be in the Fresnel zone of the receiving antenna. It is assumed that the movement of the source during the brief observation time can be ignored. The displacement and scattering of the estimate in the area of anomalous errors are determined. The equations derived can provide a well-founded selection of observations time and antenna size in order to eliminate anomalous errors and cause the characteristics of the maximum likelihood estimate to be similar to the characteristics of the corresponding effective estimate. Figures 3; references 9: 8 Russian, 1 Western. [237-6508]

UDC 621.391.1

RECEPTION NOISE IMMUNITY OF PULSE WIDTH AND FREQUENCY-MODULATED PSEUDONOISE SIGNALS

Moscow RADIOTEKHNIKA in Russian No 5, May 83 (manuscript received 5 Dec 82) pp 9-14

VARAKIN, L.Ye.

[Abstract] Pulse width modulation of a pseudonoise signal completely utilizes the transmitter power, eliminates quantization errors and there is no need for additional spectrum expansion. These factors make such modulation preferable to other digital techniques for analog messages. The only feasible analog means of pseudonoise signal modulation is FM by means of converting the analog message to a frequency-modulated signal and then additionally modulating this with the pseudonoise signal. This paper analyzes receiving and transmitting configurations for continuous messages using pulse width and frequency-modulation, where

the spectrum is additionally expanded by means of phase-keyed pseudonoise signals. Specific analytical expressions are derived for the noise immunity of these two approaches and the noise immunity is plotted showing the signal-to-noise ratio (SNR) at the receiver output as a function of the SNR at the input for various spectrum expansion factors. For FM indices, m , of 4 and 10, FM pseudonoise signals have an advantage over pulse-duration modulated signals of 17 dB and 25dB respectively, where the SNR at the input is well above the threshold level; for a threshold level SNR, the advantage when $m = 4$ is 33 dB and when $m = 10$, is 45 dB. Figures 3; references 10: 7 Russian; 3 Western in translation.
[254-8225]

UDC 621.391.1

PROBABILITY OF ERROR IN RECEPTION OF ORTHOGONAL SIGNALS WITH DISCRETE FREQUENCY MODULATION IN STRUCTURED NOISE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 13 Sep 82) pp 89-91

OBUKHOVICH, R.F., SOKOLOV, M.A. and CHADOVICH, I.I.

[Abstract] A 1979 work by the same authors studied the influence of structured noise on the probability of error of coherent reception of a phase-keyed signal with random frequency structure. This article solves the problem for widely used orthogonal signals with discrete frequency modulation. The signal in question is a full M -nary, M -position code (where M is the number of frequencies) which breaks down into M^{n-1} sets of M orthogonal signals each. In the time interval $T=N\tau$ (where τ is the length of a signal envelope) one signal from some set is presented. Selection of the signal and the frequency of its elements is considered to be equally probable. The noise structure consists of a continuous sequence of elements of the same length with independent and uniform appearance of the same frequencies. Equations are derived describing the probability of error in reception of orthogonal discrete frequency modulated signals. The equations allow in each specific case estimation of the quality of reception and effective selection of the corresponding parameters, for example in analyzing electromagnetic compatibility, multiplexing of communications channels and other similar cases. Figures 1; tables 1; references: 2 Russian.
[237-6508]

UDC 621.391.019.4

ESTIMATE OF PROBABILITY OF FALSE RECEPTION OF WIDEBAND SIGNALS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 4, Apr 83 (manuscript received after revision 17 May 82) pp 87-89

BIKKENIN, R.R.

[Abstract] A boundary condition is derived for the probability of error during noncoherent reception with linear accumulation of a noise-like signal with relative phase keying. If the noise-like signals are formed using pseudorandom

sequences, at the transmitting end an oscillation is generated which represents a sum of sectors of harmonic components with identical amplitudes and lengths but different information phases. It is assumed that reception of the useful signal is performed against a background of structured noise coinciding in frequency with the transmitted oscillations. In order to decide whether or not a signal has been transmitted, a noncoherent demodulator is used which differs from known receivers in that it contains a multiplier and a pseudo-random sequence generator similar to a transmitting stations generator intended to eliminate the pseudorandom keying. An equation is derived which is quite strict, requiring no hypothesis of gaussian distribution nor minimum a priori information on the signal received or on noise. Figure 1; references: 3 Russian.

[237-6508]

UDC 621.391.2

OPTIMAL RECEPTION OF PHASE-KEYED PSEUDORANDOM SIGNAL MODULATED AT CARRIER FREQUENCY BY INFORMATIVE MESSAGE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 5 Jun 81) pp 1000-1003

SERDYUKOV, P.N., NAUMOV, A.V. and GROMAKOV, Yu.A.

[Abstract] An optimum receiver is synthesized for signals which have been frequency-modulated by a continuous informative message at the carrier frequency of the latter and then phase-keyed according to the law of pseudorandom sequences. The synthesis is based on the theory of nonlinear filtration, assuming that the signal appears mixed with an additive white noise. In the case of a voice message the signal is represented as a two-component Markov process. The receiver structure includes a pseudorandom-sequence generator using a shift register with feedback, and two sets of tunable oscillator and control element: one in the phase-locked frequency control loop, one for tracking the time delay. The quality of filtration is determined from the solution to a nonlinear differential matrix equation for the a posteriori dispersion, with noise averaged and vibration disregarded. This equation, after insertion of a diagonal auxiliary matrix and normalization of the time coordinate, was solved on a computer by the Euler method for specific initial conditions $k_{ij}=1$ for $i=j$ and $k_{ij}=0$ for $i \neq j$ with the modulation (keying) parameter $m=2.5$. The results reveal that the transient period becomes shorter with increasing signal-to-noise ratio, filtration improves with increasing frequency-modulation index, and the a posteriori accuracy of delay time tracking improves with increasing stability of the clock oscillator. Figures 4; references: 5 Russian.

[261-2415]

COMPUTATION OF SPECTRA OF RELATED ARBITRARY BCH CODES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 26, No 4, Apr 83 (manuscript received 27 Oct 82) pp 14-19

KORZHIK, V.I. and BORISENKO, N.P.

[Abstract] The task of computing the spectrum of neighboring classes of group codes has both independent theoretical interest and great practical significance in coding theory. Knowledge of the spectra of related codes is necessary, for example, in order to evaluate the probability of errors in list decoding, in multistation access communications systems and in many other cases. This article demonstrates a statement which can be used to calculate the spectra of neighboring classes of arbitrary BCH codes by finding the number of solutions of a linear system of equations in finite fields which is derived in the article. The theorem states that the spectrum of neighboring classes $A(\bar{y})$, $\Omega < \delta$ of BCH codes assigned by a test matrix coincides with the number of different patterns of errors \bar{e}_ω of weight ω defined by solution of the equation system. In general, determination of the number of patterns of errors is a complex task requiring a great volume of computation. Its simplification requires the development of a theory allowing determination of the number of different roots belonging to the field $GF(2^m)$ for polynomials assigned in the field $GF(2^m)$. Tables 2; references 3: 2 Russian, 1 Western in translation.

[237-6508]

EQUIVALENT REPRESENTATION OF THE POSITION FIXERS FOR PULSE SIGNALS AND THEIR OPTIMIZATION

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 26, No 4, Apr 83 (manuscript received 4 Oct 82) pp 41-48

KASHINOV, V.V., and BASEVICH, Ya.S.

[Abstract] Analysis and optimization of time intervals between signal pulses is usually applicable to a specific type of device for fixing the time position of the pulses, specific signal and specific noise. Extrapolation of the results to other operating conditions, particularly other types of position fixers, is not always possible. One well-known mathematical approach represents an arbitrary random process as the result of passage of white noise through a shaping filter. The corresponding optimal filter for an arbitrary random process is represented as the union of a white filter and an optimal filter for white noise. In order to create a unified approach for the description, analysis and synthesis of various fixers, the authors utilize a similar mathematical approach. They assume that the pulse time position fixer can be represented as an elementary fixer before which a certain equivalent filter is connected, the transmission factor of which is determined by the

method of fixation. With additive white noise, the optimal equivalent filter connected for the elementary fixer is a filter matched with the arbitrary useful signal. Representation of the fixer in the form of a series connected equivalent filter and elementary fixer, followed by an optimization of it by determining the characteristics of an equivalent filter for the case of white noise, thus leads to a known optimal fixation algorithm in one possible implementation. Further analysis leads to the conclusion that an equivalent representation of various methods of fixation in the form of an elementary fixer before which a certain equivalent filter is connected has indeed been suggested. It is shown that generally where noise is slight the optimal filter is a fixer for which the equivalent filter is linear. A common feature of optimal fixation algorithm is determination of the maximum response of a linear filter whose peak characteristic is determined by the form of signal and noise plus the nature of their interaction. Tables 1; references: 10 Russian. [237-6508]

UDC 621.391.278

PICOSECOND RADIO PULSE REFLECTOMETER

Moscow RADIOTEKHNIKA in Russian No 5, May 83 (manuscript received 20 Dec 82)
pp 33-36

STRYUKOV, B.A. and MILYAYEV, P.V.

[Abstract] The design of a high resolution radio pulse reflectometer is described in nonmathematical terms with a block diagram of the circuitry showing the configuration of the transmitting and receiving-wave tubes (TWT's), triggering pulse generator, delay lines, triggered oscilloscope and test object. A 2D524 charge storage diode is used in the video pulse generator which produces 50 psec width voltage pulses with an amplitude of 15 to 20 V. Series produced TWT's are used; they have a power gain of about 37 dB in the 3 cm band and a bandwidth of 60 percent of the carrier frequency. The oscilloscope is a S7-13, which in turn drives a TDP4-002 autorecorder. The reflectometer generates a pulse with a 3 dB level width of $5 \cdot 10^{-11}$ sec for spatial resolution of $7.5 \cdot 10^{-3}$ m at frequencies between 3 and 10 GHz. The time position instability of the pulse is less than 10 psec with a pulse power of 20 W. The pulse repetition rate can vary in a range of 10 to 10^8 Hz and the receiver sensitivity is a minimum of about 10^{-10} W. Oscilloscope traces are shown for the voltage at the output of the step function voltage generator and the transmitting TWT, as well as the return signal from a test object as a function of time. The maximum output pulse power is achieved when a step voltage of about 2 V with a width of about 100 psec or 0.7 V with a width of 50 psec is fed to the input of the transmitting TWT. The reflectometer makes it possible to study various inhomogeneities in microwave channels directly in the time domain. Figures 5; tables 1; references 6: 1 Russian; 5 Western (1 in translation). [254-8225]

The authors thank V. M. Sayfert, L. Yu. Astanin, A. A. Kostylev, and A. A. Marents for support and valuable advice; Yu. I. Popov and V. I. Kelin for assistance in the work underway.

UNIFIED KEYBOARD FOR ELECTRONIC TELEGRAPH SET OPERATING WITH FIVE-ELEMENT CODE

Moscow ELEKTROSVYAZ' in Russian No 5, May 83 (manuscript received 14 Dec 81)
pp 60-63

KORDOBOVSKIY, A.I., SAKHARCHUK, S.I. and YURCHENKO, A.A.

[Abstract] A keyboard for typewriters and electronic telegraph sets has been laid out with four groups of switches, with the possibility of automatic rather than semiautomatic input of case combinations, and with the possibility of re-coding the shift of keys from Russian letters in the Government Standard 14873-79 arrangement to their Latin transliterations in the QWERTY arrangement. The spacer bar and the keys for "carriage return," "line transfer," and for digits 0-9 remain the same. The "+" symbol has a separate key, punctuation and other mathematical as well as special symbols are arranged according to Government Standard 6431-75. The keyboard thus unified facilitates operation with texts in the Latin alphabet and transition from one alphabet to the other, it also contributes to a higher productivity of telegraphists and typists while providing a tool for a standard learning process. Figures 3; references 7: 6 Russian, 1 Western.
[258-2415]

UDC: 621.396

EFFECTIVENESS OF SUCCESSIVE SEARCH FOR A SIGNAL IN CHARACTER PROCESSING OF A RECEIVED VOLTAGE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 19 Jul 82) pp 80-82

OZERSKIY, Yu. P.

[Abstract] In some pulse communications systems it is necessary to seek a periodic signal in noise. If the signal length is τ_s , its repetition period T , the task of seeking the signal based on the delay over time interval $T^s \leq T$ is equivalent to that of separating one signal time channel of $N^m = T/\tau_s$ time channels. This task is solved in successive search by repeated performance of some detection procedure. Because the desired signal is clearly present in one of the N channels, the effectiveness of the search can be estimated as the probability of proper determination of signal P and the mean time of proper search \bar{T} . Procedures for minimizing \bar{T} with fixed value of P are discussed. The results of analysis for character received voltage processing procedures are represented. Equations are derived which can be used to estimate the characteristics of sequential search for all types of processing of the received voltage, any type of detector counting the number of zeros and ones arriving at its input and comparing this number with the threshold or thresholds, and comparison of the effectiveness of using each processing type. The speed of the sequential search system using a simple character procedure is several times less than when binary quantization is used with the optimal threshold. References: 3 Russian.
[237-6808]

SEARCH FOR A SIGNAL BY FREQUENCY WITH HIGH SIGNAL-TO-NOISE RATIO

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELE TRONIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 27 Oct 82) pp 82-84

REVENOK, D.A.

[Abstract] In many electronics problems it is necessary to seek a signal. In this work, search for one harmonic signal with unknown frequency using a search device is studied. The signal frequency belongs to an area of uncertainty Δf , the accuracy with which the search must be performed being defined by Δf . Detection of a signal with an unknown frequency is performed by the implementation of the envelope of the observed process, representing either a normal steady narrow band noise with zero mean or the sum of this noise plus a deterministic narrow band signal. It is assumed that the observation time of one or several positions is greater than $1/\Delta$, where Δ is the bandwidth of the detector amplifier. An algorithm is derived for seeking a strong signal which makes possible a significant reduction in the search time without reducing the probability of proper detection. References: 2 Russian.
[237-6508]

UDC 621.396.43:621.43:621.3.019.8

METHOD OF OPTIMIZING DESIGN OF LINE-OF-SIGHT RADIO RELAY LINES

Moscow ELEKTROSVYAZ' in Russian No 5, May 83 (manuscript received 28 Nov 82) pp 45-48

RAKOV, A.I. and ASHIROV, V.K.

[Abstract] The problem of optimizing the design of line-of-sight radio relay lines is reformulated, following the latest CCIR recommendations, as a multicriterial problem of structural-parametric synthesis on the basis of a stochastic model with six vectors: 1) Vector X of uncontrollable factors (geography, climate, traffic); 2) Vector U of controllable factors (equipment design, power supply, antenna type); 3) Vector E of electrical channel characteristics other than signal-to-noise ratio; 4) Vector R of data transmission reliability; 5) Vector C of costs; and 6) Vector S of signal stability on intervals. The problem is to achieve both performance characteristics and devise a design procedure, each not worse than prescribed or optimum in some sense. Constraints are generally imposed on vectors R, C, U and it is not expedient to use these vectors as optimality criteria. Instead, the pareto-optimum sequence $\omega^*(X, U)$ of design variants in the space of given X and permissible U is sought which corresponds to preferable values of criteria $Q^*(R, C)$ (Q' being the complement of Q^* to the full set of criteria $Q = Q^*UQ'$). One design variant is selected according to an arbitrary rule such as $C = C_{min}$. Reliability is stipulated in terms of the down-time factor rather than the availability. Stability is stipulated in terms of the fraction of total time in which channel noise exceeds the permissible level during the month of the year with best fadeout characteristics.

The procedure for solving the problem consists of five steps: 1) Selection of equipment; 2) Preliminary selection of routes on small-scale topographic maps; 3) Tabulation of possible variants of high-frequency components and power supplies for each station; 4) Search for pareto-optimum solutions with discrete variables (variants differing with respect to layout or amount of standby equipment); and 5) Checkout for compliance with other CCIR 393-3 and 395-2 requirements. A simplified version of this procedure, is planned, with a radio relay line 100 km long with 3 stations and with spatial staggering of receivers for higher reliability. The algorithm of search for the pareto-optimum set of solutions is based on dynamic programming, invariant with respect to the number of criteria, and has been programmed for a YeS-1022 Unified System computer. The authors thank N.N. Kamenskiy, L.V. Nadenenko and A.N. Smantser for critical comments. Tables 2; references 5: 3 Russian, 2 Western.
[258-2415]

UDC 621.396.61:621.372.2/6

MATCHING DEVICE FOR VHF-BAND RADIO TRANSMITTER

Moscow ELEKTROSVYAZ' in Russian No 5, May 83 (manuscript received 24 Dec 82)
pp 25-27

GOLOMBEK, I.I. and KOPYLEV, B.V.

[Abstract] A new type of matching device for VHF-band radio transmitters is proposed, in which a simple-to-construct VTWR transducer and transmission line of controllable electrical length replace the difficult-to-construct phase discriminator and impedance transducer. The sequence of steps in tuning such a device is first to adjust its reactance for a definite traveling-wave ratio in the line, usually the same each time, and then to vary the electrical length of the line until its input impedance becomes purely resistive. This algorithm is compatible with the types of load of a real VHF-band radio transmitter. The most expedient form of variable reactor is a discrete bank of switchable capacitors in sizes which follow a geometric progression with ratio 2. A logic module for selecting the combination of capacitors may consist of a Kipp oscillator (monostable multivibrator) with trigger and relay for each capacitor, the Kipp oscillators connected in series through NAND-gates and each relay trigger separated from its Kipp oscillator by a NAND-gate. The NAND-gates between Kipp oscillators have their single input leads tied together and connected to one output of a comparator, the NAND-gates between Kipp oscillators and relay triggers have their second input leads tied together and connected to the other output of the comparator. The comparator receives signals from a fixed VTWR transducer in response of the latter to incident and reflected voltages. The transducer generates a "null" signal when the VTWR has become what it should be. The performance of this transducer during "balance" depends least of all on the transmitted power, the latter affecting only the slope of the transducer characteristic. Figures 3; references 5: 3 Russian, 2 Western (in translation).
[258-2415]

ALGORITHM FOR PROCESSING BINARY QUANTIZED SIGNAL FLOW WITH KNOWN PACKET BEGINNING AND END

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 4, Apr 83 (manuscript received after revision 4 Aug 82) pp 98-100

ZUYEV, S.A.

[Abstract] The purpose of this work is to find the optimal algorithms for digital processing of various models of binary quantized signals received by optimal methods against a background of additive gaussian white noise and to determine the nature of influence of the parameters and form of the distribution function of the mixture of signal and noise on the optimal logic of binary signal processing, assuming that the beginning and end of the packet of the binary quantized signal are known. The logic of processing refers to the widely used criterion of the form of k of n processing of the binary signal. The results presented in this work allow computation of the optimal value of k with any distribution of signal-to-noise. The approximate equations produced with estimates of their accuracy are useful for engineering design of detectors utilizing a k of n criterion. References 6: 5 Russian, 1 Western. [237-6508]

INCREASING TIME RESOLUTION OF SIGNALS WITH LIMITED FREQUENCY BANDWIDTH

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 7 Sep 82) pp 100-102

KIRILLOV, S.N.

[Abstract] An expression is obtained for the spectral density of the power of signals which minimizes the normalized time resolution function with a fixed value of dispersion of the time estimate and side lobe level. It is shown that as the dispersion of the time estimate increases, the level of the side lobes of the signal at the output of the matched filter drops to -40 dB. The synthesized signals assure lower values of the normalized resolution function with respect to time and dispersion of time estimates, than signals whose spectral power density have the form $k + (1-k)\cos^2 z$ for a fixed side lobe level. In many cases, additional requirements must be placed on the signals: provide minimal value of $T_r(0)$ for fixed dispersion of the estimate of delay time. This article is dedicated to a study of the properties of these signals. With a fixed band of frequencies the signals have a higher resolving capacity with respect to time than signals whose spectra is described by a more common expression, given in the article. An equation is also derived which, with an accuracy equivalent to a constant factor describes the expression for the power of passive noise at the output of a matched filter if the movement of reflectors is not considered. This means that the synthesized signals have, with a fixed dispersion of time estimate and side lobe levels, minimal passive noise power at the output of a matched filter. References: 5 Russian. [237-6508]

RADIO BROADCAST RECEIVER WITH SINGLE SIDEBAND SELECTION CAPABILITY

Moscow RADIOTEKHNIKA in Russian No 5, May 83 (manuscript received after completion 11 Dec 82) pp 28-30

BANK, M.U.

[Abstract] A crystal filter with a passband of 4 KHz for either the upper or lower sideband can be designed for selective SSB detection at a frequency of 1.84 MHz. To attain the maximum skirt selectivity with a limited number of components and an acceptable attenuation within the passband, the Q of the components should be no less than 30 and the Q of the crystals in filter should be no less than 14,000. This can be accomplished with monolithic crystal filters. This paper proposes a design which reduces the number of crystals required from 12 to 8 by having the filter composed of two equal sections, a bandpass and stop-band section, each of which can be switched to the opposite mode to provide the selectable sideband function. Expressions are derived for the harmonic distortion associated with both linear and square-law detectors for a SSB system using these filters. The square-law detector does not produce any marked distortion and only changes the "coloration" of the sound, while a linear detector introduces distortions clearly perceived by the listener. Special crystal filters and receivers with selectable SSB are now under development. Figures 1; tables 1; references: 8 Russian. [254-8225]

METHODS OF TRANSMITTING CONTROL SIGNALS OVER BUSY RADIO BROADCASTING CHANNELS (SURVEY)

Moscow ELEKTROSVYAZ' in Russian No 5, May 83 (manuscript received 17 Feb 82) pp 18-21

KACHEROVICH, Ya. A.

[Abstract] The possibility of transmitting control signals of generally short duration over busy radio broadcasting or telephone channels with unattended or semi-unattended equipment eliminates the need for building or leasing special channels. There are four basic methods available: 1) Use of bands in the radiation spectrum of ultrashort-wave FM radio or television stations which do not contain a complex stereosignal; 2) Subliminal use of busy higher-quality channels for narrow-band (15 kHz) code signals; 3) Sporadic conspicuous use of busy audio channels; and 4) Use of several narrow frequency bands within the middle range of the audio spectrum in which the broadcast program is suppressed. All these methods are applicable within short geographical ranges, but none is satisfactory for transmission of control signals over long distances or over lower-quality channels. A significant improvement here should be using the program signal in a full channel as carrier of discrete control messages, specifically a binary signal added with time delay. This can be done by superposing

on the program a coded signal, sequence of frequency-keyed or phase-keyed signals, the reliability of its detection improving with increasing complexity of the code. The code frequency should not coincide with but fall between those of the musical scale, allowing ± 2 percent untuning of instruments. A correcting code should be included for minimizing the probability of distortion of binary symbols in a given modem. The level of code signals should be automatically regulated. Cyclic synchronization of code sequences with a preliminary sequence is necessary in the case of continuous program reception, but not in the case of long start-stop messages or in the case of strong background interference. Experiments in extraction of frequency-keyed binary control signals from the program by means of quartz filters have been successful. Figures 3; references 18: 4 Russian, 1 Czechoslovak, 13 Western (2 in translation). [258-2415]

UDC 621.396.61

UNCONVENTIONAL METHODS OF COOLING INDUCTIVE COMPONENTS IN HIGH-POWER MEDIUM-WAVE AND LONG-WAVE RADIO TRANSMITTERS

Moscow ELEKTROSVYAZ' in Russian No 5, May 83 (manuscript received 2 Jun 82)
pp 15-18

VOROB'YEV, A.A. and ROZENBAUM, L.B.

[Abstract] The problem of economically increasing the power output of radio transmitters is intimately related to the problem of adequate cooling, which will permit reducing the size of and the metal content in critical components. This applies particularly to inductive and switching components. Liquid dielectrics are very suitable for this application, not only because of their high heat dissipating capacity and electrical strength but also because they lower the electrical resistivity of metals appreciably when the temperature is sufficiently lowered. The feasibility of two basically different unconventional cooling methods is examined here on the basis of heat balance and power relations. One method is cooling with cryogenic liquids, helium for cooling superconductors and nitrogen for cooling cryoconductors. Another method is cooling with high-boiling liquids such as organofluorine compounds (perfluorotriethylene, perfluorodibutyl ether) with transition from pool boiling to film boiling. Each variant is evaluated on the basis of coolant properties and conductor design, also taking into account the parameters of equipment (cryostat, boiler) design and performance. Calculations are shown for a split variometer used in PSV-2000 medium-wave and long-wave radio transmitters. Liquid nitrogen has the highest heat dissipating capacity of approximately 20 W/cm^2 , but cryogenic cooling with nitrogen or with helium (1 W/cm^2) requires special equipment and an extra power supply. Organofluorine compounds with a heat dissipating capacity of $10\text{--}15 \text{ W/cm}^2$ have the disadvantage of being somewhat toxic. For comparison, the maximum power dissipation by natural air cooling is on the order of 0.1 W/cm^2 at 30°C . Tables 1; references: 7 Russian. [258-2415]

ULTIMATE POSSIBLE ESTIMATES OF SIGNAL DELAY TIME IN STRICT CONFLICT SITUATION

Moscow RADIOTEKHNIKA in Russian No 5, May 83 (manuscript received 3 Nov 82)
pp 47-51

ZHODZISHSKIY, A.I. and ZHODZISHSKIY, Yu. I.

[Abstract] The optimal estimate of the delay time of a signal received against a background of normal white noise background is well known, where the optimal form of the transmitted signal responsible for the potential precision of the measurement, i.e. the minimum dispersion of the estimate, is specified. This paper attacks this problem using game theory for a broader class of interference, incorporating jamming, whose structure can change for the purpose of maximally increasing the estimate error. Formulated in this way, the problem reduces to finding the ultimate possible capability of determining the dispersion of the estimate in the presence of a strict conflict. The question of the practical feasibility of such systems is not addressed in this paper, and the games theory approach does not relay on any limitations such as the absence of internal noise, use of a receiver filter matched to the signal against the white noise background, or limiting the class of signals to just those with unilateral rectangular envelope spectra. The conflict situation is represented in the form of an antagonistic game where player 1 is the designer of the estimation system and player 2 is the jammer. An additive mixture of the useful signal, interference and internal normal white noise having a unilateral spectral density is fed to the receiver input of the estimation system. The signal is completely known at the receive point while it is being transmitted and its spectrum is limited to a specified range of frequency. The interference is independent of the signal and normal. It is shown that previous results for the optimum estimation of the signal delay time found in the literature are a special case of the more general expression derived in this paper. The dispersion of the measurement estimate given here, neglecting internal noise, is $5/3$ times as small as that in a paper by Nillson (IRE NAT. CONV. REC., 1959, Vol 7, No 4), because of which, the limitations on the permissible set of signals are eliminated in this approach. Figures 3; references 5: 2 Russian; 3 Western (2 in translation).
[254-8225]

UDC 681.325

ANALOG-TO-DIGITAL CONVERTER FOR DATA TRANSMISSION EQUIPMENT

Moscow ELEKTROSVYAZ' in Russian No 5, May 83 (manuscript received 15 May 81)
pp 49-52

TSIREL'SON, D.A., SEDOV, V.I., KALYNYUK, V.A. and MELIKHOV, I.B.

[Abstract] The technical requirements which analog-to-digital converters for data transmission modems with tone-frequency and pulse-width-modulation channels must satisfy are reviewed in a systematic manner, as a basis for production of these devices by the "Mikropribor" Industrial Association in L'vov.

These requirements are essentially based on the relation $x = mD + \lambda\Delta$ between an analog quantity x and its digital equivalent D in a linear conversion process (Δ - discretization step, $\lambda = 1$ or 0 , m - scale factor). Converter performance parameters relevant to the choice of conversion algorithm are passband, resolution (number of bits for adequate noise immunity), conversion speed, dynamic range of input signal, input impedance within operating frequency range, quantization error, maximum normalized scale error and differential scale nonlinearity, temperature coefficients of gain drift and null voltage drift. The digital value of a convertible quantity must be presented in a parallel complementary binary code. The new MF 4802 analog-to-digital converter meets the CCIR performance specifications, with the d.c. supply voltage (± 15 V, ± 12.6 V, $+5$ V) fluctuating not more than 5 percent and with stable operation at ambient temperature from -10°C to 70°C . The converter, together with an analog memory and a reference voltage source as well as a comparator with feedback control, is built with series 133 and 155 integrated microcircuits in the 1/0 logic. The comparator is built with KMP816SA1/2 hybrid-film devices. The voltage-to-code converter has 10 bits, including one bit for the sign, and operates at a speed of $6\ \mu\text{s}$ (clock frequency 66 MHz). The maximum normalized scale error and the differential scale nonlinearity are both not larger than $\pm \frac{1}{2}$ LSB (last significant bit). Its frequency range is 0-110 kHz with the input impedance equal to 100 kohm at 110 kHz. Figures 2: references 6: 4 Russian, 2 Western. [258-2415]

DEVELOPMENT OF ELECTRICAL APPARATUS AUTOMATED PLANNING SYSTEM

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 3, Mar 83 (manuscript received 29 Jan 82; after completion, 27 Jul 82) pp 73-79

NIKITENKO, ALEKSANDR GRIGOR'YEVICH, candidate of technical sciences, dotsent, Novocherkassk Polytechnical Institute

[Abstract] The process of planning electrical apparatus must be based on the systems approach which requires development of an automated planning system. The system approach to planning significantly changes the sequence and content of the steps in the process of developing apparatus, as well as the relationship between design and experimental operations. The automatic planning system must: 1) Demonstrate the need to develop a series of apparatus; 2) Compose a technical assignment for planning considering the requirements of the organizations responsible for technical supervision; and 3) Supervise the process of utilizing standardized parts and elements in order to develop optimal hardware designs. Optimization of hardware design is performed by nonlinear or dynamic programming methods. The creation of an electronic apparatus automatic planning system requires significant expenditures, and should therefore be performed for entire groups of apparatus of similar design. Novocherkassk Polytechnical Institute has developed and is successfully using a system for automated planning of electromagnetic mechanisms, the technical base of which is a YeS-1022 computer, the drafting-graphic "Itekan-2m" automat and other devices. Figures 1; references: 17 Russian.
[239-6508]

A SYSTEM OF ORTHOGONAL FUNCTIONS FOR SPECTRAL RAPID ANALYSIS OF SIGNALS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 5, May 83 (manuscript received 27 Aug 82) pp 37-41

KLIKOVA, Ye. F. and KUKHAREV, G. A., Leningrad Institute of Precision Mechanics and Optics

[Abstract] The properties are presented of a system of functions which are discrete exponential functions quantized to three levels (± 1 and 0). The

functions are called complex rectangular functions, and are functions of two equivalent variables. They are periodic with known period. References: 6 Russian.
[263-6508]

UDC 681.3-181.48

APPLICATION OF MICROCOMPUTERS IN TEST PULSE GENERATORS

Moscow RADIOTEKHNIKA in Russian No 5, May 83 (manuscript received 19 Jan 83)
pp 56-59

LIPINSKIY, G.V., TIMOFEYEV, A.O. and TRIFONOV, A.T.

[Abstract] Three test pulse generators are described: G5-79 which incorporates the "Elektronika S5-31" single chip microcomputer (K586VYel IC); G5-80 which uses the "Elektronika S5-12" single board microcomputer and the GK5-83 which employs a microcomputer based on a set of microprocessors from the K589 series. Each of these generators consists of a control section based on the microcomputers as well as the measurement circuitry. The G5-79 generates single, double and a series of square-wave, trapezoidal, triangular and sawtooth waveform pulses with widths of from 50 nsec to 100 sec. The G5-80 is a 16-channel code sequence ("word") generator with a maximum clock frequency of 50 MHz, a maximum code sequence length of 2,048 - 8,192 bits or clock cycles in each channel. The pulse width and time shifts are adjusted separately in each channel and the generator can produce various binary codes or functions in a parallel or series code as well as test and sync signals in a complex multidimensional time pattern. The GK5-83 is a pseudorandom pulse train generator having a code sequence analyzer. It is designed to detect and measure errors which occur during data transmission via digital communications channels and provides for both closed loop operation at frequencies of up to 50 MHz. Block diagrams of the three units are given and their programming is discussed. The use of microcomputers has made it possible to implement standard diagnostic, self-diagnostic, automated self-testing and calibration functions. As instrument functions increase along with the number of input parameters and operating modes, it will be necessary to go to higher performance data displays. Figures 3; references: 8 Russian.
[254-8225]

UDC 681.3:519.2+621.317.08

ALGORITHMS AND STRUCTURES FOR SPECTRAL CORRELATION SIGNAL CONVERTERS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 5, May 83 (manuscript received 3 Jun 82) pp 41-44

KONTOROVICH, V.P., Tol'yatti Polytechnical Institute

[Abstract] Several algorithms are suggested for spectral correlation conversion of signals allowing an increase in metrologic reliability of estimation of the

processes studied. Based on equations derived in the work, a spectral analyzer can be combined with a correlator. Instruments are noted which partially or completely utilize the operation of spectral and correlation analysis. A figure illustrates the flow of the algorithm suggested. The paper was recommended by a Department (Kafedva) of Theoretical Electrical Engineering and Electronics, Tol'yatti Polytechnical Institute. Figures 1; references: 4 Russian.
[263-6508]

UDC: 621.316.923

GENERAL ANALYSIS OF RESEARCH AND DEVELOPMENT OF FUSES BASED ON IDENTIFICATION AND OPTIMIZATION THEORY, PART 1

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 3, Mar 83 (manuscript received 21 Dec 81) pp 80-86

NAMITOKOB, KEMAL' KADYROBICH, doctor of technical sciences, Professor at Kharkov Institute of Municipal Service Engineers; IL'INA, NATAL'YA ALEKSANDROVNA, candidate of technical sciences, senior scientific research worker, VNIIElektroapparat, (All-Union Scientific-Research Institute of Electrical Equipment (Kharkov); SHKLOVSKIY, IL'YA GRIGOR'YEVICH, candidate of technical sciences, senior scientific research worker, VNIIElektroapparat (Kharkov)

[Abstract] The set of various tasks encountered in the development of low-voltage apparatus can be divided into two great classes, identification and optimization. Identification is similar to analysis, optimization to synthesis of the best version. Identification presupposes establishing the qualitative and quantitative interrelationships between parameters of the object and the medium, such as the parameters of a fuse and the protective characteristics of the fuse. The selection of a model structure and the shape of the task of approximation are outlined along with classical methods for its solution. Typical identification tasks encountered in the practice of development and design of low-voltage apparatus are listed as examples, including those encountered in the development of the PP-59 series of fast acting fuses. The approach which uses Kolmogorov-Mordashev transforms, based on an approximation of the functions of many variables by a function of a smaller number of variables, is found to have advantages, including increased accuracy of the model by mathematical transforms without increasing the required volume of experimental work in the process of design optimization. Classification of models of apparatus by their method of construction can significantly simplify the procedure of research and design. References 6: 5 Russian, 1 Western.
[239-6508]

BIFURCATION PARAMETER OF STOCHASTIC FREE OSCILLATIONS IN GUNN DIODE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 3 May 82; in final version 6 Sep 82) pp 512-514

BOCHAROV, Ye.P. and KOROSTELEV, G.N., Saratov State University

[Abstract] The strong noise-like oscillations which occur in Gunn diodes in the initial segment of the "falling" portion of the volt-ampere characteristic have many of the attributes of stochastic free oscillations characteristic of distributed dynamic systems. Such oscillations obey the likelihood laws derived from the equations for system dynamics; this behavior is manifest in the existence of a dimensionless parameter which determines the bifurcation of the system. This paper is an attempt to determine whether the observed oscillations in Gunn diodes are caused by amplifications of microfluctuations or are in fact stochastic self-oscillations. The latter occur in that range of system parameters corresponding to instability in the periodic solutions, which means that they occur in a diode with the propagation of a steady-state nonlinear wave, a strong field domain (soliton). For a domain moving along an infinitely long homogeneously doped sample, the stability of this type of solution requires that G_R be less than 1, where

$$G_R = [R_{\text{load}} / (U_{\text{supply}} - U_{r \text{ min}})^{3/2}] C$$

and $U_{r \text{ min}}$ is the minimum voltage drop across the domain and C is a constant for each diode. To ascertain whether G_R is a bifurcation parameter, GaAs Gunn diodes in low-Q microwave resonators were studied in order to observe their oscillatory behavior. For certain values of the electron concentration (n_0/n_{critical} less than 1), it appears that G_R is such a bifurcation parameter, although this is not the case for large values of n_0/n_{critical} . Because the condition that G_R be less than 1 was derived assuming that n_0 is much less than n_{critical} , the result is in good agreement with the conclusion of domain solution stability theory and it is now of interest to look for a universal bifurcation parameter suitable for diodes where n_0 is much greater than n_{critical} .

The authors are grateful to D.I. Trubetskov for helpful discussion of the work.
Figures 1; references: 5 Russian.
[255-8225]

UDC 621.382.029.64

EFFECT OF HIGHER CUTOFF FREQUENCY ON PERFORMANCE ON GUNN-EFFECT DIODES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 6 Jul 81) pp 1016-1018

PROKHOROV, E.D. and LYADCHENKO, A.V.

[Abstract] The cutoff frequency of intervalley-electron-transfer devices operating with limited space-charge accumulation can be raised by application of a voltage signal which contains a second harmonic in addition to the fundamental component. The voltage then remains longer near the threshold level and the electron concentration at the center dip of the conduction wave in the material is restored to a higher level than in the case of a simple sinusoidal signal, especially at high frequencies. This increases the amplitude of the alternating component of electron drift velocity and drift current, resulting in a decrease of the phase shift between current and voltage so that the cutoff frequency becomes higher. The effect on the performance of an n-GaAs Gunn-effect diode was evaluated and confirmed theoretically as well as experimentally. The frequency dependence of the power generation efficiency of an oscillator with an n-GaAs Gunn-effect diode was calculated on the basis of the equation of Boltzmann kinetics, at lattice temperatures from 300 to 500 K, with scattering of electrons by acoustic, polar and nonpolar optical, intervalley and intravalley phonons taken into account. Measurements were made with n-GaAs diodes in a waveguide-stripline oscillator cavity between the wide wall and plunger, the latter inserted through a microwave filter. These diodes have an electron concentration $n = (2 \cdot 10^{15} - 10^{16}) \text{ cm}^{-3}$ and an active region of length $L = 1-10 \text{ }\mu\text{m}$. The quantitative differences between theoretical and experimental results are attributable to the fact that the former are based on ideal limited space-charge accumulation, while the latter have been obtained for the diodes operating in resonance-transit or hybrid modes with attendant nonuniform heating. Figures 1; references: 2 Russian.
[261-2415]

UDC 621.383

PHOTOCAPACITANCE OF SILICON MOS-STRUCTURES IN ULTRAVIOLET RANGE OF SPECTRUM

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 2 Mar 82) pp 1018-1019

ZUYEV, V.A. and POPOV, V.G.

[Abstract] Photovaricaps based on Si-SiO₂ MOS-structures should have a high sensitivity, not only to visible and near infrared light but also to ultraviolet light, inasmuch as their space-charge region is embedded close to the

surface. For an investigation of this possibility, the phot capacitance of such varicaps on n-Si ($\rho = 7.5 \text{ ohm}\cdot\text{cm}$) at 1 MHz at room temperature was measured with a superhigh-pressure xenon lamp serving as light source and a semi-transparent layer of nickel serving as a field electrode. The measurements were made in a linear mode, with constant number of incident photons, in the range of inversion bending of energy bands. The results confirm the predicted high photosensitivity in ultraviolet light, the phot capacitance being generally higher at shorter wavelengths. They indicate only a small absorption of light by both Ni and SiO₂ layers as well as by the phot capacitiv Si layer, also only a small recombination loss at the surface and within the subsurface space-charge region in silicon in devices produced by modern technology (recombination losses in devices produced by the diffusion process are higher). The results can be explained by an increase of the quantum yield with increasing incident photon energy and by a charge exchange between the Si (or Ni) and SiO₂ layers at quantum energy levels higher than the interphase potential barriers. The monotonic increase of phot capacitance with decreasing wavelength is interrupted by spectral anomalies attributable to critical points in the Brillouin zone in silicon. Figures 1; references 8: 6 Russian, 2 Western.

[261-2415]

UDC [621.314.26:621].003.1

INTRODUCTION OF THYRISTOR CONVERTER TECHNOLOGY - AN IMPORTANT MEANS FOR SAVING ELECTRIC POWER AT THE VOLGA MOTOR VEHICLE PLANT IMENI 50TH ANNIVERSARY OF THE USSR

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 6, Jun 83 pp 6-7

SHIPITSYN, V.V., candidate of technical sciences, GAYEV, L.G., engineer, Ural Polytechnical Institute imeni S.M. Kirov, TRET'YAKOV, V.S., candidate of technical sciences and KHUDOTEPOV, A.I., engineer, Volga Automobile Plant imeni 50th Anniversary of the USSR

[Abstract] As the production program of the motor vehicle plant increases, the problem of increasing the effectiveness of operation of electrical equipment becomes more severe. One major means for saving electric power at the plant is replacement of obsolete converter equipment. One great shortcoming of the type VGVF machine converters now used is the great variation of efficiency as a function of load, which is quite irregular in the plant. It was decided to replace machine converters with thyristor frequency converters, which have higher efficiency (up to 92 percent), less variation of efficiency with load, no losses at idle during shutdown and which are easier to repair. They also require fewer personnel to service and maintain them. Operational characteristics of the units installed in the foundry are presented. Successful experience in operation of thyristor equipment has solved the problem of replacing rotating converters by thyristor converters. The experience of the use of thyristor converters at the Volga Motor Vehicle Plant has shown that they are highly reliable, permitting not only a savings of electric power, but also a significant increase in service life and a reduction in required maintenance and the number of maintenance personnel. References 9: Russian. [268-6508]

UDC: 536.6

METHODS AND DEVICES FOR UNSTEADY HEAT MEASUREMENT AT CRYOGENIC TEMPERATURES

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian
Vol 26, No 5, May 83 (manuscript received 17 Sep 82) pp 89-92

PILIPENKO, N.V. and KLYUCHEV, V.M., Leningrad Institute of Precision Mechanics and Optics

[Abstract] Results are briefly presented from the development of methods and creation of devices for unsteady cryogenic heat measurement. Experiments have shown that during measurements in the area of helium temperatures, preference must be given to resistance thermometers consisting of germanium, carbon or gallium arsenide. When strong magnetic fields are present measurements are performed using carbon resistance thermometers. Platinum and germanium resistance thermometers are used for high precision measurements. Several mathematical models and calculation equations are presented for methods of determining unsteady heat fluxes to be used in the solution of practical problems as in cryoturbogenerator design. A technology has been developed and a number of original heat meters created implementing a new method, which requires that the temperature of the surface of the heat meter be known at any time. This requires the application of a resistive coating which must be uniform and thin, well bounded to the substrate and have good thermometric properties. A carbon coating with grains of about 10^{-8} m diameter was developed for the purpose. Results of testing showed that instability of a resistance of the thermometers after 3 thermal cycles from 300 to 4 K was not over 0.5 percent. The paper was recommended by the Department (Kafedra) of Thermal Physics, Leningrad Institute of Precision Mechanics and Optics. Figures 2; references: 6 Russian.
[263-6508]

UDC: 621.317

MICROWAVE METHOD FOR CHECKING CURING OF MATERIALS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian
Vol 26, No 5, May 83 (manuscript received 21 Sep 82) pp 93-96

MASLOV, V.V., Leningrad Institute of Precision Mechanics and Optics

[Abstract] This article presents the results of development and testing of a microwave method for checking the curing of materials in products. The method

is based on recording changes in the modulus of the coefficient of reflection of electromagnetic waves from the object. Experiments were performed on an installation consisting primarily of a double waveguide bridge, which permits the curing of materials to be studied under laboratory conditions. The modulus of the coefficient of reflection of electromagnetic waves from the object can be used as a primary recorded parameter in order to monitor curing of materials and products. The major condition required to assure high sensitivity of the method and reliability of the results produced is proper selection of the relationship of the band of change of dielectric properties of the material tested, the wave-length of probing radiation and the thickness of the layer tested. The results of theoretical analysis of the interaction of an electromagnetic wave with a layer of a dielectric permits the optimal conditions for checking the curing of various materials to be determined. The paper was recommended by the Department (Kafedra) of Electronics, Leningrad Institute of Precision Mechanics and Optics. Figures 3; references: 4 Russian.
[263-6508]

UDC: 621.317.725

AC TO DC MEASUREMENT CONVERTERS IN AN AMPLITUDE SELECTOR

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 5, May 83 (manuscript received 7 Jul 82) pp 3-7

VOLGIN, L.I. and YEFIMOV, A.V., Ulyanovsk Polytechnical Institute

[Abstract] A new method is suggested for construction of AC to DC converters allowing a significant reduction in low-frequency error and expanding the frequency band in the low-frequency direction. The purpose of the work is to determine the greatest possible accuracy which can be achieved by the new method, which is based on the use of the amplitude sector of an analog logic element performing the operation of selection of the larger or smaller of two signals. The operating principle of the amplitude selector is explained. A schematic diagram of the converter is presented, along with an equivalent circuit of a converter constructed using an active amplitude selector, which means one controlled by the voltage of the voltage source. The physical expansion of the frequency band toward lower frequencies is explained by the introduction of a capacitor to the feedback tracking circuit, which is equivalent to increasing the discharge time constant by a factor equal to the inverse of the undercompensation error. The paper was recommended by a Department (Kafedra) of Construction and Production of Radio Equipment, Ulyanovsk Polytechnical Institute. Figures 2; references: 6 Russian.
[263-6508]

RADIATION METER FOR MEASURING TEMPERATURE OF WATER SURFACE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83
(manuscript received 16 Oct 81) pp 32-33

POVARKOV, V.I., IVANOV, N.Ye., KABANIN, V.F., KAMOLOV, Yu.Z. and SAMKOV, V.M.

[Abstract] A prototype of a universal radiation meter for measuring the temperature profile of an ocean surface has been developed with sufficient sensitivity to temperature fluctuations in terms of both amplitude (0.02°C) and frequency (0-10 Hz). It consists of an optical receiver, an electronic signal processor, a power supply, and an automatic chart recorder and a magnetophone. The optical system contains two identical channels, one for radiation from the water surface and one for radiation from the reference source mounted on a rotatable sectoral shutter together with a thermistor-type temperature probe. The objective in each channel is followed by a plane mirror, a semitransparent lattice mirror, a filter, a stop, a condenser lens, and a radiation receiver - a semiconductor immersion bolometer without cooling. A motor-driven disk modulates the radiation for each objective at a frequency of 60 Hz. An auxiliary modulator generates a constant-voltage signal at the carrier frequency of the radiation receivers signal. The electronic system contains two identical amplifier and converter channels for signals from the radiation receivers, amplification and conversion of the synchronizing signal, suppression of the reflected signal component for minimizing the error of measurement of the intrinsic thermodynamic water surface temperature, and signal separation for widening the dynamic range of signal transmission and recording without loss of high sensitivity. Figures 2; tables 1; references 7: 6 Russian, 1 Western. [248-2415]

UDC: 621.391.029.7

METRICS OF MULTIMODE FIBER LIGHT GUIDES AND PROBLEMS OF STANDARDIZATION OF MEASUREMENTS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 18 Oct 82) pp 18-26

BELOV, A.V. and NEUSTROYEV, V.B.

[Abstract] A brief review is presented of the most common methods for measurement of the basic optical characteristics of multimode fiber light guides, such as optical losses, the profile of the index of refraction, numerical aperture and light pulse time dispersion. An attempt is made at comparative evaluation of various methods, showing the causes for possible divergences in results in measurements made in different laboratories. In the discussion of various methods of measurement of the basic optical characteristics of fiber light guides the primary task is to provide an objective estimate from the standpoint

of fiber light guide developers, whose goal must be to create fiber light guides with certain required properties. In order to perform this task, measurement methods are required which eliminate the ambiguity of results. However, in planning fiber optic communications systems measurement of fiber light guide characteristics has a different purpose, and it is more desirable to approximate the measurement conditions to the conditions of operation of the planned system. Figures 9; references 15: 6 Russian, 9 Western.
[264-6508]

UDC: 629.179.14

CALCULATION OF CONVERSION FACTOR OF MAGNETIC MODULATION MEASUREMENT CONVERTERS WITH PULSED EXCITATION

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian, Vol 26, No 5, May 83 (manuscript received 27 Apr 81) pp 7-11

YAKOVENKO, V.V., PAVLYUKOV, V.F. and VOROB'YEV, N.G., Voroshilovgrad Machine Building Institute

[Abstract] An analysis is presented of the operation of a magnetic modulation measurement converter which has an open core. A schematic diagram is presented. The converter is excited by a voltage consisting of single-pole rectangular pulses. A mathematical model of its operation is constructed using the following assumptions: 1) The influence of eddy currents in the core is considered by inserting a resistor connected in parallel to the exciter winding; 2) Dissipation current and capacitance between turns are ignored; 3) The output winding of the converter is considered open; and 4) The hysteresis loop of the material of the core in the first quadrant is replaced by an average curve passing through the middle of the loop of the frequency cycle of the core, magnetized to the state of technical saturation. Equations are derived which can be used to determine the amplitude of the output signals of the converter for various time ratios and measured field variations. An equation is given for the conversion factor of the device. Figures 3; references: 4 Russian.
[263-6508]

UDC 778.38:621.3.029.6

KINOHOLOGRAPHY WITH MICROWAVES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 21 Jan 82) pp 975-976 + 2 unnumbered pp with pictures

GINZBURG, V.M., NIKOLAYEV, F.Ya. AND STEPANOV, B.M.

[Abstract] A microwave kinoholographic apparatus has been developed and built for measurement of dynamic objects and processes. It operates by the "perturbed field" method (D.M. Swingler and A.P. Anderson, ELECTRICS LETTERS Vol 5, No 14,

1969 p 314) with a diode array (proposed by I.F. Strukov and constructed at the Voronezh State University). It includes a "Titus" electron beam light modulator and a DKDP crystal. Holograms are displayed on a VK-23 video monitor constituting a part of the PTU-29 special-purpose television equipment. A continuous signal generated by the microwave oscillator is transmitted through the horn antenna into the anechoic chamber and along the reference-wave channel to the mixer also acting as a synchronous detector. The object wave, scattered by the object, impinges on the square diode-scatterer array in the hologram plane. The dimension of the array is $D^2 = 25\lambda \times 25\lambda$ with a 0.8λ distance between diodes, the latter acting as linear vibrators under a modulated (at constant frequency of the order of 1 MHz) load of radio pulses. Both shadowgrams and holograms can be obtained, at a speed of 20 frames/s, with the distance from object to diode array $R_1 = (1-3)\lambda$ or $R = 90\lambda$ respectively and the angle between signal wave and reference wave $\alpha = 0$ or 30° respectively. The distance from horn to diode array is $R_0 = 180\lambda$. The resolution is not worse than $\delta \approx 3\lambda$, corresponding to the theoretical limit $(\lambda/D)R_2$. With this apparatus it is possible to reconstruct images from dynamic holograms and observe them in real time. Figures 4; references 3: 2 Russian, 1 Western. [261-2415]

UDC: 621.318.2

IMPULSE MAGNETIZATION OF PERMANENT MAGNETS IN CLOSED ELECTRICAL APPARATUS
CIRCUITS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in
Russian No 3, Mar 83 (manuscript received 20 May 81; after completion 27 Oct
81) pp 87-90

ASTAPOV, VIKTOR IVANOVICH, junior research worker, All-Union Scientific-Research,
Planning-Design and Technological Institute of Relay Construction (Cheboksary);
VASIL'YEV, VALENTIN VASEL'YEVICH, senior scientific-research worker, All-Union
Scientific-Research, Planning-Design and Technological Institute of Relay Con-
struction (Cheboksary); NESTERIN, VALERIY ALEKSEYEVICH, Candidate of Technical
Sciences, dotsent, All-Union Scientific-Research, Planning-Design and Technologi-
cal Institute of Relay Construction (Cheboksary)

[Abstract] A study is made of a method of magnetization of permanent magnets
in the closed magnetic circuits of products during assembly. Such magnetization
has the advantages of simplicity of the technological process, improved quality
of apparatus assembly, increased productivity of assembly labor and the ability
to change the magnetization of the magnet to permit its optimal utilization and
to regulate output parameters of the electrical apparatus in the assembled state,
thus decreasing cost. Use of a special single-turn inductor for magnetization
of permanent magnets in a closed magnetic circuit in electrical apparatus is
considered. A single-turn inductor, made of a high conductivity material, can
be complex in shape, assuring the necessary configuration of the magnetizing
field and its proper localization. Figures 2; references: 2 Russian.
[239-6508]

MAGNETOSTATIC WAVES WITH COMPLEX WAVE NUMBERS IN LOSSLESS FERRITE FILM

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 5, May 83 (manuscript received 7 Aug 81) pp 955-959

VUGAL'TER², G.A.

[Abstract] A lossless ferrite film in a magnetic field H_0 parallel to the yz-plane of its surface is considered, and propagation of surface magnetostatic waves with complex wave number along the film in the y-direction (transverse to the magnetic field) is analyzed from the standpoint of energy transfer. The dispersion equation is derived from the corresponding equations of magnetostatics with conventional boundary conditions, in terms of the corresponding two components of the permeability tensor

$$\mu_{xx} = 1 + \frac{\omega_0 \omega_M}{\omega_0^2 - \omega^2} \quad \text{and} \quad \mu_{xy} = -i \frac{\omega \omega_M}{\omega_0^2 - \omega^2} \quad (\omega - \text{frequency, } \omega_0 = \gamma H_0, \omega_M = \gamma 4\pi M, \gamma -$$

gyromagnetic ratio, M - saturation magnetization), and is solved for the fre-

quency range $\sqrt{\omega_0(\omega_0 + \omega_M)} < \omega < \omega_0 + \frac{1}{2}\omega_M$ within which surface magnetostatic waves exist. The complex Poynting vector is averaged in time and its evaluation reveals that the net energy transferred by these waves is zero (opposite and equal energy fluxes inside and outside the film). The results are extended to a ferrite film with ideal metal coating, then also to cylindrical and open waveguides with nongyrotropic filler. The corresponding expressions for the Poynting vector indicate that waves with complex wave numbers have a longitudinal magnetic field component but cannot be hybrids. The author thanks A.M. Belyantsev and Yu.A. Otmakhov for helpful discussions. Figures 2; references 6: 4 Russian, 2 Western.
[261-2415]

UDC: 53.082.6

CALCULATION OF THERMAL VOLTAGES IN INTEGRATED MICROCIRCUITS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 5, May 83 (manuscript received 28 Oct 82) pp 79-84

ZHURAVLEV, V.M., MANZHIKOVA, S.Ts. and RABKOVSKIY, I.G., Frunze Polytechnical Institute

[Abstract] This article proposes a method for determining the temperature fields and thermal voltages originating in integrated microcircuit crystals subjected to local heat sources and nonuniform heat exchange conditions with the environment. The Dul'nev-Akayev averaging method is used for the first time to determine the thermal voltage field. The work contains the results of analytic and experimental testing of the equations suggested. The equations derived establish the interrelationship between design parameters of microcircuits, thermophysical properties of their elements and the characteristics of thermal effects. The field of thermal voltages in the crystal is looked upon as the response of the microcircuit to thermal effects. A two-factor experiment with simultaneous exposure to shock and temperature was used to test the calculated data. It was found that the temperature effect did not have a great influence on the mechanical strength of the products up to temperatures near the maximum. Only at more than 250°C or 350°C for two different types of microcircuits did the temperature become significant. The paper was recommended by the Department (Kafedra) of Automatics and Telemechanics, Frunze Polytechnical Institute. Figures 3; references: 3 Russian.
[263-6508]

UDC 534.232.621.382

ACOUSTOELECTRONIC DEVICES ON ALUMINUM NITRIDE FOR DATA PROCESSING

Moscow MIKROELEKTRONIKA in Russian Vol 12, No 3, May-Jun 83 (manuscript received 8 Feb 82) pp 226-230

PASHCHIN, N.S., KISELEVA, E.N., YAKOVKIN, I.B., KUDAKOV, U.D. and SOKOLOV, Ye. B., Institute of Semiconductor Physics, Siberian Department, USSR Academy of Sciences

[Abstract] Aluminum nitride is a suitable material for interdigital surface-acoustic-wave transducers in various microwave electronics and data processing applications. Single crystal thin films of this material with a high-grade

surface finish are producible by high-temperature decomposition of $\text{AlCl}_3 \cdot \text{NH}_3$. For an experimental feasibility study, such films were grown epitaxially at various temperature to thicknesses of 1-6 μm on 20-50 mm wide and 150-300 μm thick Al_2O_3 (sapphire) wafers. The polished active wafer surface was made to coincide with the (0112)-plane and the interface to coincide with the AlN (11 $\bar{2}$ 6)-plane, the projection of the [0001] $\alpha\text{-Al}_2\text{O}_3$ axis on the interface perpendicular to the projection of the AlN [0001]-axis on that interface. Various passive interdigital transducer structures were fabricated from these ingots by the photolithographic process, namely multitap delay lines and band filters. The delay lines with 3,4,5 taps and a group delay of 0.4-5.8 μs were tested in a microwave oscillator operating at three frequencies (696.2, 726.2, 756.7 MHz) and generating sinusoidal 30-75 mV signals. Their performance characteristics, frequency dependence of equivalent resistance and capacitance as well as dependence of the electromechanical coupling coefficient on the length of the sound guide, are comparable with those of delay lines on ST quartz. The performance characteristics of the band filters, amplitude-frequency characteristics and 2-dB bandwidth as well as insertion loss, squareness factor, attenuation in delay band and phase velocity of surface acoustic waves, are comparable with those of band filters on YZ-cut LiNbO_3 crystals. The results establish the suitability of photolithographically produced $\text{AlN-Al}_2\text{O}_3$ structures for passive SAW devices with a fundamental frequency of 1.5 GHz, a frequency 1.5-2 times higher than the operating fundamental frequency of conventional single-crystal sound guides. Figures 5; tables 1; references 6: 3 Russian, 3 Western.

[249-2415]

UDC 621.382

MICROELECTRONIC DEVICES BASED ON THIRD-ORDER NONLINEAR ACOUSTOELECTRONIC EFFECTS

Moscow MIKROELEKTRONIKA in Russian Vol 12, No 3, May-Jun 83 (manuscript received 28 Jun 82) pp 231-236

SLAVUTSKIY, L.A. and SOLODOV, I.Yu., Moscow State University

[Abstract] A study was made of acoustically asynchronous four-wave interactions of surface and volume acoustic waves in layered structures. The test structure consisted of a piezoceramic substrate, a YZ-cut LiNbO_3 crystal with regular trapezoidal cross section (10° slant). On its wider upper surface there was symmetrically deposited two 15 MHz SAW transducers on the inside and two 30 MHz SAW transducers on the outside. On the narrower lower surface there was deposited a 30 MHz ShVAW (volume acoustic shear wave) transducer, and on each of the two opposite slanted lateral surfaces there was deposited a 30 MHz LVAW (longitudinal volume acoustic wave) transducer. Above the substrate were placed semiconductor specimens (p-Si, photosensitive CdS, p-n diode arrays). The following third-order nonlinear effects were observed: 1) Interaction of 30 MHz SAW with accompanying it slanted 30 MHz ShVAW and opposing it 15 MHz SAW, resulting in formation of a 75 MHz uniform electric field; 1a) Reverse interaction, producing a 15 MHz SAW; 2) Interaction of 15 MHz SAW with opposing it 30 MHz slanted LVAW and 30 MHz ShVAW, resulting in formation of a 75 MHz uniform electric field; 2a) Reverse interaction, producing a 15 MHz SAW; 3) Interaction of

45 MHz pumping field with 30 MHz slanted LVAW and 30 MHz ShVAW, producing a 15 MHz SAW; 4) Interaction of two opposing 15 MHz SAW and 30 MHz ShVAW, resulting in formation of a 60 MHz uniform electric field. The amplitude of the triple-convolution signal (1,2,4) and that of the triple-correlation signal (1a, 2a,3) was measured as a function of the voltage across the input transducers and as a function of the electrical conductivity of the semiconductor crystal (CdS). On the basis of these data the effectiveness was evaluated of such four-wave interactions, characterized by an internal-power-loss factor. The results indicate the feasibility of performing integral transformations such as convolutions and correlations with three signals by means of four-wave interaction. Practical applications include acoustoelectronic convolvers and correlators with functional control by means of a third input signal, optimal filtration with arbitrary weight function added to test and reference signals, analysis of non-stationary processes, adaptive Fourier transformation of FM signals without linear frequency-modulation filters, and synthesis of radiation patterns with spatially distributed antenna arrays. Figures 6; tables 1; references 11: 7 Russian, 4 Western (1 in translation). [249-2415]

UDC 621.382

INTEGRATED MICROCIRCUIT OF STROBOSCOPIC MIXER

Moscow MIKROELEKTRONIKA in Russian Vol 12, No 3, May-Jun 83 (manuscript received 13 May 82) pp 275-277

KOZLOV, A.T., STAROSEL'SKIY, V.I., SUETINOV, V.I. and TIMOSHENKOV, V.P.

[Abstract] Stroboscopic mixers are used, along with analog-to-digital converters, for digital data processing in measuring instruments. A study was made of the integrated version of such a mixer on a GaAs structure. In its design the conventional discharge resistor had been replaced with a switch circuit and a differential transistor pair selected for signal reading with maximum attainable sensitivity and accuracy. The storing capacitor, a critical circuit component, can be very small (0.01 pF), which also ensures its full charging at frequencies reaching into the gigahertz range. The transistor of the amplifier stage can be connected as: 1) A voltage emitter-follower with base disconnected or grounded and signal picked off the emitter; 2) A single-stage amplifier with base disconnected or grounded and signal picked off the collector with a transfer ratio much higher than unity; 3) An emitter-follower with base connected to the emitter and signal picked off the latter with a transfer ratio possibly higher than unity; 4) A single-stage amplifier with base connected to the collector and signal picked off the latter with stabilization of the transfer ratio near unity. Experiments were performed on a chip with a Polycor substrate and with an asymmetric microstrip line serving as channel for the input signal. Measurements have confirmed the excellent performance characteristics of such a mixer; a bandwidth of 2-3 GHz and a transfer ratio near unity at a noise level not exceeding 0.5 mV. Figures 2; references: 4 Russian. [249-2415]

THROUGHPUT CAPACITY OF CHANNELS FOR ROUTING IN BASIC CHIPS

Moscow MIKROELEKTRONIKA in Russian Vol 12, No 3, May-Jun 83 (manuscript received 26 Mar 82) pp 262-267

ALYUSHIN, M.V. and KARMAZINSKIY, A.N., Moscow Institute of Engineering Physics

[Abstract] Basic chips (bazovyye kristally) are used for large-scale micro-circuit integration because of their versatility, which offers huge saving of design time and design cost. Their effectiveness is determined by the throughput capacity of their channels for routing, referred to some given probability of tracing all interconnections. It is evaluated here on the basis of a chip model with the logic elements laid out in parallel rows separated by routing channels. A basic chip with three variable photostencils forming two commutator layers with contact windows is considered for specificity. The throughput capacity of the channels depends on structural parameters of the chip (number of logic elements, functional complexity, geometry of fixed interconnections), on complexity of the switching pattern, and on characteristics of the automatic design system such as the efficiency of its layout and tracing algorithms. The density of interconnections crossing the 00*-section at the center of a chip, where it usually is maximum, serves as a measure of the throughput capacity. The effect of design automation and the regularity of designed circuits as well as the frequency of utilization of stocked logic elements and the law of distribution of interconnections along a channel must be taken into account. On this basis, the mean number of output leads feeding into a channel and its dispersion are calculated first for a random arrangement of logic elements in rows and then taking optimization into account. Figures 3; references 8: 4 Russian, 4 Western.
[249-2415]

ETCHING OF POSITIVE ELECTRON AND X-RAY RESISTS DURING IRRADIATION BY MEDIUM-ENERGY IONS

Moscow MIKROELEKTRONIKA in Russian Vol 12, No 3, May-Jun 83 (manuscript received 31 Aug 82) pp 195-199

VALIYEV, K.A., DANILOV, V.A., PESHEKHONOV, S.V., RAKOV, A.V. and SHCHUCHKIN, A.G., Institute of Physics, USSR Academy of Sciences

[Abstract] A study was made of the etching effect of ion bombardment on positive electron and x-ray resists. Films of polymethyl methacrylate and of polyhexene sulfone were deposited on silicon or thermal SiO₂ substrates and dried at 170°C and 90°C, respectively, then bombarded with 25-200 keV $^{14}\text{N}^+$ ions in an accelerator with oilless suction. The films were 0.4-1.3 μm thick, and the ion current varied within the 0.2-0.45 $\mu\text{A}/\text{cm}^2$ range. The experiments have revealed that irradiation of these resists with doses larger than 10^{13} ions/ cm^2 causes partial etching, with the thickness of the removed layer Δd depending

on the irradiation dose D according to the relation $\Delta d = B \cdot \log(D/D^*)$ over a wide range (D^* - dose at which etching begins corresponding to $\Delta d = 0$ on linearly extrapolated $\Delta d = f(D)$ curve, $B = (\Delta d)_{D=10D^*}$). The mechanism of this phenomenon is interpreted theoretically in terms of breakdown processes in the polymer and formation of volatile film fragments. The initial film thickness plays an important role here, namely in a film with an initial thickness much larger than the projected mean-free-path of ions there radiative-chemical transformations occur while the irradiation dose changes from D^* to D and the film thickness, correspondingly, from d_0 to $d_0 - \Delta d$. On the basis of this interpretation the constant B is evaluated in terms of electron collision energy and nuclear collision energy with a reaction yield of film fragments removed by vaporization and a reaction yield of film fragments cross-linked by diffusion. From the fundamental relation between etched layer thickness and ion irradiation dose a simple expression is then derived for the variable etching rate. The results of this study indicate that the etching process in such resists during ion bombardment cannot be used for "xerolithography," because the process ceases at some residual film thickness. The authors thank V.A. Dravin and A.V. Spitsyn for performing the ion implantation, R.Kh. Makhmutov for performing the electron lithography, and M.N. Filippov for photographing the structures under a scanning electron microscope. Figures 3; references 8: 5 Russian, 3 Western. [249-2415]

UDC 621.382.323.015.5+546.681'19

MECHANISMS OF BREAKDOWN IN STRUCTURES OF GaAs FIELD-EFFECT TRANSISTORS

Moscow MIKROELEKTRONIKA in Russian Vol 12, No 3, May-Jun 83 (manuscript received 28 Oct 82) pp 217-225

KERNER, B.S., KOZLOV, N.A., NECHAYEV, A.M. and SINKEVICH, V.F.

[Abstract] An experimental study of GaAs field-effect transistors with a Schottky barrier has revealed several phenomena which precede irreversible breakdown. The experiments were performed on test structures consisting of epitaxial n-GaAs films on GaAs<Cr> substrates with AuGe/Au-antigate and Al-gate contact tabs. Measurements were made with voltage applied between source and drain ("gateless" device) or between gate and source only, also in the transistor configuration. The drain-source current-voltage characteristic has an initial N-range followed by an S-range with a stable constant-current range between them, both N and S ranges with "jumps" and attendant hysteresis. The trend of this characteristic largely depends on the illumination. Glow "points" in the drain region appear in addition to a rather uniform glow "trail," sweeping from drain to near the source. The gate-drain current-voltage characteristic indicates avalanche breakdown followed by an N range without jumps and then an S-range with "jumps," avalanche breakdown being irreversible in thin structures and becoming independent of the film thickness in thick structures (film thicknesses, respectively smaller or larger than the width of the space-charge region). The results and their interpretation suggest several possible mechanisms leading to breakdown, among them current saturation, formation of enhancement domain (or dipole domain at the gate) with intensified electron entrapment in deep levels, depletion of deep levels with subsequent recombination, hole drift to the $n^-(\text{buffer})$ -layer,

formation of current filaments and lamina, also thermal breakdown occurring in the cutoff mode. The authors thank S.Yu. Buslayev for assisting in the microanalysis of failed structures and V.V. Osipov for helpful comments. Figures 4; references 21: 15 Russian, 6 Western.
[249-2415]

UDC 621.382:537.312.62

DYNAMIC OF MAGNETIC FLUX QUANTA IN PERIODIC JOSEPHSON STRUCTURES WITH PARAMETRIC CONTROL

Moscow MIKROELEKTRONIKA in Russian Vol 12, No 3, May-Jun 83 (manuscript received 14 Apr 82) pp 237-243

ZUBKOV, A.A. and LAPIR, G.M.

[Abstract] Magnetic flux quanta (vortices) in long quasi-one-dimensional periodic Josephson structures can be made to propagate through such a structure either by means of external control currents inducing an additional magnetic flux, or by use of a superconductor ring containing a Josephson junction with variable critical current as structural cell. The dynamic behavior of magnetic flux quanta in such structures with parametric control is analyzed here theoretically on the basis of a 2(1)-loop 3(2)-branch equivalent electric circuit with a Josephson junction in each branch, the center branch opening for the current (and magnetic flux) to pass from the first loop to the next one. The system of equations relating the magnetic fluxes and the corresponding electric loop currents as well as the superposed magnetic flux and the external control current with the phase differences between successive junctions has been formulated for a nonhomogeneous structure. It has been solved for the case of equal critical currents of all three junctions and for each varied from minimum to nominal level. The dependence of the minimum flux transfer time on the minimum critical current of the center junction and the dependence of energy dissipation on flux transfer time have been determined on this basis. The results are applied to a shift register with single magnetic flux quanta. Its performance is evaluated on the basis of corresponding equivalent-circuit equations, the latter reduced from differential to difference form. Here the flux transfer time is calculated as a function of the controlling magnetic flux, whereupon the maximum permissible variance of critical currents and the minimum switching time for operation of the device are established. The nonidentity of junctions must and now can be taken into account in the design. The authors thank P.A. Bakhtin, V.I. Makhov and A.N. Samusi for the interest, also V.K. Semenov for comments. Figures 6; references 9: 6 Russian, 3 Western.
[249-2415]

CHARACTERISTIC CURVE OF HETEROGENEOUS MEDIUM FOR RECORDING OF OPTICAL DATA

Moscow MIKROELEKTRONIKA in Russian Vol 12, No 3, May-Jun 83 (manuscript received 5 July 82) pp 244-256

KABYCHENKOV, A.F., Institute of Radio Engineering and Electronics, USSR Academy of Sciences

[Abstract] Two theories are constructed for the characteristic curve of heterogeneous optical data recording media, after the relation between optical density and structural parameters (size of particles, particle distribution and concentration, film thickness) has already been established. The relation between structural changes and exposure causing them presents a multiparticle problem of motion for magnetic particles illuminated in an external field. Such a problem cannot be solved rigorously and only two other approaches are feasible. In the phenomenological theory a heterogeneous medium is treated as a continuous one with an absorption coefficient varying appropriately from the unmolten region to the molten region and with the evolution of the temperature profile calculated on this basis, taking into account thermal diffusion and preservation of heat balance. In the microscopic theory all particles are split into pairs of closest neighbors with the center-to-center line at a smaller than critical angle to the direction of the field. Calculations according to this theory are based on pairwise magneto-dipole interaction of particles, with each pair "particle" having a cross section for absorption which decreases with exposure time. Both models yield a satisfactory agreement with experimental data, the phenomenological theory being more general with regard to mechanisms of changes in the absorption coefficient. Calculations are aided by a transformation of coordinates which allows reduction of the problem with moving boundary to one with stationary boundary, and by a Laplace transformation for the propagation of the melting front from a spherical particle at the center of a spherical binder cell with subsequent inverse Laplace transformation according to the Stefan condition. The authors thank Yu.F. Sokolov and V.G. Shavrov for the interest and valuable comments, also Ya.A. Monosov for helpful criticism and L. Bulakhova for performing the numerical calculations. Figures 6; references 14: 6 Russian, 8 Western (3 in translation).

[249-2415]

UDC: 621.31.004.4:621.311

FUNCTIONAL CAPABILITIES OF ELECTRIC ENERGY ACCUMULATORS IN POWER SYSTEMS

Moscow ELEKTRICHESTVO in Russian No 4, Apr 83 (manuscript received 3 May 82)
pp 1-7

ASTAKHOV, Yu. N., candidate of technical sciences, VENIKOV, V.A., doctor of technical sciences, IVANOV, A.M., candidate of technical sciences, LIDORENKO, N.S., corresponding member, USSR Academy of Sciences, MUCHNIK, G.F., doctor of technical sciences, TER-GAZARYAN A.G., KHARITONOV, V.F., engineers, Moscow

[Abstract] Power systems can now include basically new devices to handle the problems of regulation of active and reactive power -- electric energy accumulators. There are many different types of energy accumulators which in principle can significantly improve the functioning of modern power systems. This article studies the capabilities of these accumulators and notes the requirements of power systems for them. A table shows various types of accumulators, including those which accumulate energy and electromagnetic or electrostatic fields such as new types of capacitors. Ways of connecting energy accumulators to power systems are noted. Operating modes of accumulators, including charging, storage, discharge and emergency modes, are briefly described. The possibility of using energy accumulators as multifunctional devices capable of performing a number of tasks is noted. These include: 1) Satisfaction of consumers with variable load schedules by means of power plants with constant output; 2) Assurance of balance of active and reactive power at points of connection of accumulators; 3) Maintenance of constant voltages at certain points on the power system; 4) Assurance of static stability of possible operating conditions of the system; and 5) Regulation of the flow of exchange power between power systems. Studies have shown that in systems where the effectiveness of decreasing power losses is important, the economic effect of the use of accumulators increases as they come closer to the consumers of power. In these situations, new types of capacitors operating at relatively low power are the most effective. Figures 3; tables 2; references 4: 3 Russian, 1 Western.
[267-6508]

ACCIDENT-FREE WORK - A COMPLEX PROBLEM

Moscow ELEKTRICHESKIYE STANTSII in Russian No 4, Apr 83 pp 12-14

LOKTEV, B.G., engineer, Novo-Salavat Heat and Electric Power Plant (TETs)

[Abstract] The Novo-Salavat Heat and Electric Power Plant of Bashkir ASSR Power has operated for 12 years without an accident. The workers at the plant attempted to plan the equipment, manufacture, install, adjust and start it into normal operation in full agreement with the state standards and technical conditions so that each man servicing the equipment can assure uninterrupted operation by proper handling of the operating controls within the design parameters. This required servicing personnel not only to know, but to have the ability and desire to perform all of the instructions of the applicable documentation. The workers of the plant, teams at the laboratory and scientific research institutes have undertaken work to improve further the plans and designs for boilers and turbines, which has resulted in revision of the protective and control systems, reconstruction of boilers and other equipment, strengthening of electrical insulation of the 110 kV distributor and an increase in the degree of automation of the plant. A logical automatic system for regeneration of filters is used in the chemical shop. There are 2727 automatic regulators and relay devices in operation at the powerplant, including 841 automatic regulators and process protection devices. However, there are still many shortcomings and unsolved problems. In 1982 there were 32 failures of operation of equipment, primarily caused by damage to steam generating boilers, including 3 failures caused by operator error.

[266-6508]

EFFECTIVENESS OF INTRODUCING 'SUMMER' TIME FOR MOSCOW POWER SYSTEM

Moscow ELEKTRICHESTVO in Russian No 4, Apr 83 (manuscript received 30 Sep 82) pp 55-56

MAKOKLYUYEV, B.I., VORONKOV, V.N. and LOGINOVA, L.V., engineers, Moscow

[Abstract] Selection of the optimal period for active human activity with maximum utilization of daylight hours can reduce the consumption of electric power for illumination, smoothing peak hours of consumption in the evening. Some 50 nations in the world use "summer" time [daylight savings time], saving 500 million kW·hr of electric power, 1.3 percent of the total consumption for illumination and 0.2 percent of the total annual electric power consumption in West Germany alone. In 1981, summer time was tested in the USSR from 1 April through 30 September. This article suggests a method for estimating the effectiveness of summer time in power conservation and uses the method to estimate the savings of electric power during the summer season for the Moscow Power System. The method is based on comparing adjusted mean monthly load graphs of power consumption over a period of several years. The most positive effect of summer

time was found to be in April, the least in July. The total savings of electric power for the Moscow Power System for the 6 months period was 204 million kW·hr, 12 kW·hr per resident of the area. The results for Moscow are affected by its location at 56°N. The results might be different for power systems in other latitudes. Figure 1; references 3: 2 Russian, 1 Western.
[267-6508]

UDC: 621.314.6:537.312.62.001.57

EXPERIMENTAL MODEL OF SUPERCONDUCTING 1000 A CONVERTER

Moscow ELEKTRICHESTVO in Russian No 4, Apr 83 (manuscript received 14 Sep 82)
pp 56-57

IGNATOV, V.Ye., KUZ'MIN, A.V. and SKOBARIKHIN, Yu.V., Power Engineering Institute imeni G.M. Krzhizhanovskiy

[Abstract] The use is considered of Superconducting converters in systems which power superconducting MHD generator exciter windings, unipolar machines and dc motors, as well as superconducting inductive accumulators and magnetic separators. In such large power installations with a magnetic field inductance of 5 Tl, the density of stored energy is 10^7 J/m³, the current from 1 to 10 kA. Where the operating conditions allow input of energy to the superconducting magnetic system, the power consumption of the superconducting converter should range from a few watts to 1 kW. A number of versions of supply systems have been suggested. This article studies an experimental model of a superconducting converter operator into a superconducting inductive load. The system consists of a cryotron converter, control and power supply system, measurement and monitoring system. The cryotron converter is a double half period system with a center point and contains a superconducting transformer of solenoid type without a ferromagnetic core and two magnetically controlled cryotrons with valves of lead foil with 2.27 percent Sb, 20 μ m thick. The resistance of the valve in the resistive state at 4.2 K is $1.26 \cdot 10^{-3}$ ohm. The control windings of the cryotron consist of an Nb-Ti winding 0.33 mm in diameter, and have an inductance of 0.0202 H. The mass of the cryotron is 1.35 kg. Figures 3; references 3: 2 Russian, 1 Western.
[267-6508]

UDC: 621.315.1.027.3.064.2:005

EXPERIENCE OF OPERATION OF OVERHEAD 35-750 kV ELECTRIC POWER TRANSMISSION LINES

Moscow ELEKTRICHESKIYE STANTSII in Russian No 4, Apr 83 pp 48-50

GERR, A.D. and DIDENKO, E.V., engineers, Soyuztekhenenergo

[Abstract] According to data obtained from all reports of emergency and non-standard situations in Soyuztekhenenergo for 1981, all failures of overhead power transmission lines in the 35-750 kV range can be classified as follows: 5 percent were emergencies, 40 percent were class 1 failures and 55 percent were

class 2 failures. Most of the failures were caused by atmospheric effects, wind loads exceeding calculated values causing 12.4 percent, ice loads 3.1 percent and combined wind and ice loads 3.9 percent. Lightning surges caused 12 percent of power line failures. Analysis of failures in October-November of 1981 indicates a failure to consider properly the combined effects of wind and ice during planning of power transmission lines. Instructions assume that the ice forming on a power line will have a mass of 0.9 g/cm^3 . Actually frost is formed with a density of $0.2\text{--}0.4 \text{ g/cm}^3$, meaning that although the weight calculated is correct, the area upon which the wind acts is much greater than that called for in the standards, so that combined ice and wind loads are greater than the design loads in some cases. Several emergency situations which resulted from this design error are briefly described. Suggestions are made for improving the reliability of power transmission lines: during the frost season, utilize maps of standard wind loads which were developed at the scientific research institute; assure that the planned requirements and standards documents are always met during construction of power lines concerning correct mounting of towers in the soil and their installation on foundations; assure that acceptance for operation of newly constructed power transmission lines is in strict accordance to their plans with no defects or shortcomings; and intensify monitoring of observance by the population and other organizations of the rules for protection of electric power transmission networks.

[266-6508]

UDC: 621.315.1:621.316.932

PROTECTION OF POWER TRANSMISSION LINES FROM ARC-OVERS CAUSED BY LARGE BIRDS

Moscow ELEKTRICHESKIYE STANTSII in Russian No 4, Apr 83 pp 58-61

BOCHKOVSKIY, B.B., UDOD, Ye.I., SHERENTSIS, A.N., YASINSKAYA, N.V., engineers
All-Union Scientific Research Institute of Power Engineering, Ukrainian SSR,
Ministry of Power Engineering

[Abstract] Many failures of 110-330 kV power transmission lines have occurred in recent years in the Ukraine, in most cases caused by arc-over of insulation on the lines caused by landing of storks on the lines. The arc-over mechanism is discharge from the mast transference to the line through a stream of dung from the bird. Recommendations have been developed for the protection of 110-330 kV power transmission lines from storks and other large birds. Consultation with ornithologists confirm the opinion that it would be impossible by sight or sound signals to frighten the birds from the line towers, because they would soon become accustomed to the signals. Therefore, the main means of prevention of power line failures caused by birds is to install special guards on the towers in order to prevent birds from landing on the towers above the insulators or power transmission lines. Based on the dimensions of the birds, designs of vertical spikes have been developed for this purpose. Because the bird's legs are quite long, the spikes must be equally long in order to prevent landings. Typical designs are diagrammed. Figures 4; references 5: 4 Russian, 1 Western.

[266-6508]

RESULTS OF INTRODUCTION AND OPERATION OF FIXED INSTRUMENTS FOR DETERMINATION OF 110-750 kV POWER LINE DAMAGE LOCATIONS

Moscow ELEKTRICHESKIYE STANTSII in Russian No 4, Apr 83 pp 50-53

AYZENFEL'D, A.I., candidate of technical sciences, Soyuztekhenenergo

[Abstract] Data are presented on the dynamics of the increase in the number of fixed instruments on 110-750 kV power lines used to determine the location of damage sites during the period 1971 to 1981. During this time, the number of such instruments increased by a factor of 2.5, reaching 13,472 in the 87 power systems and the unified electric power system, some 95 percent of the instruments being of type FIP manufactured by the Riga Experimental Plant "Energo-avtomatika." Some 90 percent of the total length of power lines over 20 km in length are equipped with such devices, including 100 percent in 18 power systems. The error in determination of the distance to a damage location is random, normally distributed. Improvement in the quality of manufacture of fixed instruments, improvement of their operational servicing together with the use of optimal computer based calculation methods can increase the effectiveness of remote determination of the location of damage based on the parameters of the fault condition. At present the effectiveness of location of unstable short circuit sites is 33 percent. Tables 3.

[266-6508]

SOME RESULTS OF UTILIZATION OF 750 kV ELECTRIC POWER TRANSMISSION LINES

Moscow ELEKTRICHESTVO in Russian No 4, Apr 83 (manuscript received 16 Nov 82) pp 12-14

YERSHEVICH, V.V. and KRIVUSHKIN, L.F., candidates of technical sciences, VGPI (probably All-Union State Planning Institute) and "Energosetproyekt" (All-Union State Planning, Surveying and Scientific Research Institute of Power Systems and Electric Power Networks)

[Abstract] It has been 10 years since 750 kV power transmission lines began to be constructed in the European USSR. These new lines have significantly increased the throughput capacity of power transmission lines, allowed the output of power from a number of large electric powerplants, and created the possibility of transition to parallel operation of the unified USSR Electric Power System with the combined power system of CEMA member nations, accompanied by a significant increase in the delivery of power and energy and the scale of implementation of energy integration. These 10 years have seen a number of corrections and refinements in the design of 750 kV lines, so that it is only now possible to go over to standardization of the design of such lines, 750 kV substations and equipment. The significant influence of factors of uncertainty of initial information should be considered in selecting parameters for new stages of electric power transmission, and the general regularities of system development should be more thoroughly considered. Tables 1; references 4: Russian.

[267-6508]

RETAINING HIGH EFFICIENCY IN BRIDGE POWER SUMMATION

Moscow RADIOTEKHNIKA in Russian No 5, May 83 (manuscript received 22 Sep 82)
pp 73-75

LONDON, S.Ye., LESHCHEV, B.V. and TOMASHEVICH, S.V.

[Abstract] In any power amplification and distribution circuit where the output of a preamplifier is fed through a n-channel divider to the inputs of n identical output amplifiers to be combined at the outputs of these amplifiers in a common load by a bridge n-channel adder, the failure of any output amplifier causes a loss of efficiency. This is because not all of the power of the remaining final amplifiers goes to the common load, but is dissipated in the isolating resistors of the adder. This paper analyzes some ways of designing bridge power summation systems so that with the failure of some of the final amplifiers, independent operation of the remaining ones is assured, along with the delivery of the bulk of their overall power to the common load. Two of the approaches use switched coupling transformers while a third circumvents switching difficulties through a special transformer configuration. In the latter and preferable case, the minimum power adding efficiency is 97 percent. Figures 4; references 3: 1 Russian, 2 Western.
[254-8225]

UDC: 621.375.126

STARTING UNIT OF AUTOMATIC RESERVE POWER UNIT MADE OF RESONANT SEALED SWITCHES

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 3, Mar 83 (manuscript received 16 Mar 81; after completion 8 Jul 81) pp 117-118

BORODENKO, VITALIY ANATOL'YEVICH, engineer Ural Polytechnical Institute; KLETSEL', MARK YAKOVLEVICH, candidate of technical sciences, senior teacher Ural Polytechnical Institute; POLYAKOV, VALENTIN YEFIMOVICH, doctor of technical sciences, professor Ural Polytechnical Institute

[Abstract] The units which start the operation of high-speed automatic reserve power switches at substations with motor loads contain two frequency monitoring units for each sectional power supply, the unit with the lower setting used to start the automatic equipment for its section, the unit with the higher setting used to block operation of the automatic redundancy section. Modern devices containing frequency monitoring units thus are rather complex. It is therefore desirable to seek a new hardware base for the implementation of frequency devices. This article suggests the use of a magnetically controlled resonant sealed switch (gerkon) operating in the vibrating mode at a frequency close to the natural frequency of mechanical oscillations of the moving contact. Loss of power on a motor load causes a continuous drop in frequency of the voltage generated with a slow change in its level. This causes the system to operate, bringing on the reserve power supply. Characteristics of closure of sealed switch contacts are illustrated graphically. Figures 2; references: 4 Russian.
[239-6508]

UDC: 531.252.6

VIABILITY OF GRADIENT LIGHT GUIDES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 67-70

ALEKSANDROV, I.V., ZHABOTINSKIY, M.Ye. and SHUSHPANOV, O.Ye.

[Abstract] In a cable, a light guide is subject to physical tension which is added to thermoelastic stresses. The light guide breaks down under the influence of the tension applied to it, causing the development of defects either on the surface or within the light guide. These defects are represented by the inert transparency of the glass, usually measured at low temperatures so that slow processes of crack growth because of corrosion and thermal fluctuation are not included. A mathematical model of the gradual failure of a light guide is developed, providing an apparatus for estimating reliability, and allowing in particular optimization of light guides based on this parameter. The model is also suitable for analysis of other methods of increasing reliability, for example, improving the initial distribution of surface defects, hydraulic isolation of the surface, use of wetting coatings and various methods of thermoelastic stress redistribution. Figures 1; references 11: 5 Russian, 6 Western. [264-6508]

UDC 535.231.62

SPECTRAL CHARACTERISTICS OF SILICON BOLOMETERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83 (manuscript received 16 Mar 81) pp 48-50

PANKRATOV, N.A., KULIKOV, Yu.V. and POLUSHKIN, Yu.I.

[Abstract] The spectral sensitivity of a silicon bolometer over the 18-500 μm range of wavelengths was measured at high levels of ambient radiation power, without cooled filters. The bolometer was made of KES silicon with an electrical resistivity $\rho = 6.2 \cdot 10^4 \text{ ohm}\cdot\text{cm}$ at 4.3 K and a "jump" conductivity activation energy $E_t = 2.2 \cdot 10^{-3} \text{ eV}$. The bolometer had a receiver pad area $3 \times 3 \text{ mm}^2$, a power sensitivity $S = 3.4 \cdot 10^4 \text{ V/W}$, a time constant $\tau = 5 \cdot 10^{-3} \text{ s}$, and a noise equivalent power $p = 2 \cdot 10^{-12} \text{ W/Hz}^{1/2}$. Measurements were made in a vacuum cryostat, with radiation entering through a white polyethylene window collected by a converging conical gold tube. Measurements were made with the bolometer bare (smooth

silicon surface) and with an absorbent ferrite coating (rough surface), the spectral sensitivity being higher in the latter case with minimum interference effect and in both cases increasing slightly with the wavelength. The bolometer sensitivity was determined on the basis of comparison of the output signals with those of an OAP-5 optoacoustic receiver placed alongside in the vacuum compartment. Measurements were also made without and with failure in the tube, the power sensitivity peaking to a much higher level of volts per watt at a much smaller bias current with filters. The same sensitivity in both cases was, for the purpose of quantitative correlation, achieved by adjustment of the bias current. The spectral characteristics of the polyethylene window and filters were measured separately, for purposes of calibration, selection, and tuning. Figures 4; references 13: 6 Russian, 7 Western (1 in translation). [248=2415]

UDC 535.243

METHOD OF DETERMINING SPECTRAL POLARIZATION CHARACTERISTICS OF DEVICES FOR TELEMETRY OF NATURAL ENVIRONMENT

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83 (manuscript received 28 Jul 82) pp 10-12

BELYAYEV, B.I., ZAYTSEVA, V.A., PLYUTA, V.Ye., and YANOVSKIY, A.F.

[Abstract] A method has been developed for calibration of spectrometric instruments which takes into account both the polarization characteristic of such an instrument and the degree of polarization of incident radiation. The gist of this method is determination of the absolute spectral sensitivity, namely the ratio of output voltage to spectral density of the incident radiation intensity. The relations governing the instrument performance and which are necessary for its evaluation, are derived with the aid of an etalon, specifically for MSS-2 small fast-response spectrometers. The calibration procedure, with an SI8-200U luminometer lamp used as an etalon, consists of two steps. First the instrument is calibrated with respect to wavelength, using sources of line spectra and interference-type filters. Then the instrument is calibrated with respect to spectral sensitivity, disregarding the polarization of incident radiation, with the polarization characteristics of both instrument and etalon determined subsequently. The calibration equipment also includes, in addition to the etalon, a collimator with an incandescent filament in its focal plane, a set of three neutral attenuating filters in the path of radiation before a diaphragm, and two sources of line spectra: a PRK-4 mercury-arc lamp and a GSh-3 neon glow-discharge lamp. For polarization measurements the following are inserted behind the diaphragm: 1) Polarizer plant (dichroic polaroid) which is, rotatable into positions parallel or perpendicular to the slit; 2) Adjustable intensity equalizing depolarizer; and 3) Polarization cancelling depolarizer. The accuracy of calibration depends on at least seven possible systematic errors, which do not add up to an overall rms error larger than 9.3 percent and 7.6 percent for spectral density of incident radiation intensity lower than $5 \cdot 10^{-4}$ W/(cm²·μ·sr) and higher than 10^{-2} W/(cm²·μ·sr), respectively. Figures 2; references 13: 10 Russian, 3 Western. [248=2415]

EFFECT OF TEMPERATURE VARIATION ON DIVERGENCES OF LIGHT BEAMS REFLECTED BY LIGHT BEAM REVERSING PRISMS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83 (manuscript received 28 May 82) pp 46-47

SMIRNOV, L.A., ZAKHAROV, P.P., YERMOLOVA, S.N., MALEVANNYY, A.I. and FADEYEV, O.G.

[Abstract] High-precision glass and quartz prisms are used in telemetry and geodesy for reflecting light beams, visible and near infrared, along a parallel return path. The use of BaF_2 crystals would extend the effectiveness of this method to light beams in the far infrared range (10-15 μm). A problem here is the thermal expansivity of this material, much higher than that of quartz. The effect of temperature variation over the 100-(-60) $^{\circ}\text{C}$ range on the divergence of reflected light beams were measured in an experimental study using a TBV-8000/2 temperature-pressure chamber with a glass window. Several light beam reversing prisms of FRB BaF_2 crystals were mounted without clearance in AMG-6 aluminum alloy holders (similar coefficients of thermal expansion) with an adjustable ring and placed at the window inside the chamber, along with a control prism of KU-1 quartz glass. The test equipment also included a light source with objective lens, a camera with objective lens, a light filter, an ocular-micro-meter, an autocollimator, and a pentaprism. The results of direct visual readings and readings on photographs indicate that the divergence of light beams reflected by prisms of either barium fluoride or quartz glass remains constant, within 20-25%, over the entire -60-(+100) $^{\circ}\text{C}$ temperature range. Figures 3; references: 1 Russian.
[248-2415]

PRESENT STATE OF ART AND DEVELOPMENT TRENDS IN FIBER-OPTIC TRANSDUCERS OF MECHANICAL QUANTITIES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83 (manuscript received 9 Jan 82) pp 57-60

GRECHINSKIY, D.A. and PATLAKH, A.L.

[Abstract] All fiber-optic transducers of mechanical quantities reducible to displacement (vibrations, pressure, acceleration) can be classified into those where the fiber only transmits optical signals and those where the fiber converts mechanical perturbations to optical signals. The first group includes instrument transducers with the interaction space in an open optical channel and converters with two light guides, one for the primary signal from radiation source to test object and one for the useful secondary signal from test object to photoreceiver. In this group also belong scanning transducers and multipoint transducers with multilayer coaxial light guides for preventive indication of

limiting vibration amplitudes. Transducers of the second group operate on the basis of various physical principles such as change in the coupling between light guides, change of the polarization plane or in the phase of the optical signal, change in the refractive index of materials, and loss of total reflection caused by mechanical action through smooth or microdiscrete change of curvature. A major problem in transducers with loss of total reflection is a large constant signal component, a solution to this problem being a compound light guide with two channels (triple-layer fiber with inner and outer channel). Transducers with microdiscrete deflections are highly sensitive. They can be designed for telemetry and analysis of vibrations. Figures 6; references 34: 23 Russian, 11 Western (6 in translation).
[248-2415]

UDC: 535.417

VARIATION IN SENSITIVITY OF FIBER OPTIC TRANSDUCER AS A FUNCTION OF FIBER CHARACTERISTICS AND SENSING ELEMENT DESIGN

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 81-82

BUTUSOV, M.M., YERMAKOVA, N.V. and URVANTSEVA, N.L.

[Abstract] The sensitivity of a phase fiber optic pressure transducer is determined by the physical and mechanical parameters of the material, its elastic-optical coefficients and fiber length. An experimental study was performed on the sensitivity of a two-arm single-mode fiber optic pressure transducer as a function of fiber coating and sensing element design. A homodyne fiber optic pressure transducer (Mach-Zander interferometer) was used with single mode optical fiber in the measuring and reference branches. Quartz single mode fiber was used with epoxy varnish coating (light guide core diameter 8 μm , reflecting shell diameter 60 μm , varnish film thickness 3 to 4 μm and covered with capron shell, conducting core 8 μm , reflecting shell diameter 50 μm , capron shell thickness 800 μm . The experiments showed that the use of fibers with coatings with a low modulus of elasticity (capron) can increase the sensitivity of the fiber optic transducer by 20 dB. References: 3 Russian.
[264-6508]

UDC 535.822.5

EQUIPMENT FOR REPRODUCING PHOTOGRAPHIC PATTERNS BY PROJECTION METHOD

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83 (manuscript received 10 Dec 79) pp 27-29

LARINA, R.M., YEGOROVA, I.M. and YEGOROVA, O.V.

[Abstract] New equipment has been developed for reproducing photographic patterns by the project method. A mirror-lens objective rather than an "Avangard" or "Mikronar" copying objective is used here, with a DRSh-250 superhigh-pressure

mercury-arc lamp as a light source. Other components of this PP-89 equipment include a pair of magnifying collector lenses with an iris between them which project the shape of the light source, after reflection by a 45° mirror and passage through a stop, onto the principal plane of the first of a second pair of lenses, the latter separated by an illuminance equalizing fiber plate, then a filter, and a condenser lens which projects the source image into infinity and the stop onto a photographic templet. A special achromatic stereoscopic microscope with two eyepieces coupled through two sets of mirrors to a common objective is provided for alignment and image control. The equipment has excellent performance characteristics, namely minimal decentering of the objective indicated by breakup of the diffraction ring and minimal astigmatism and coma at the periphery with satisfactory image sharpness and contrast throughout the field of vision. Figures 4; references 10: 6 Russian, 4 Western (1 in translation).
[248-2415]

UDC: 537.8

ACOUSTICOELECTRONIC PARAMETRIC AMPLIFICATION OF IR AND VISIBLE BAND ELECTROMAGNETIC WAVES IN PLANAR OPTICAL WAVE GUIDES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 71-72

KALAPUSHA, A.L. and KOTSARENKO, N.Ya.

[Abstract] This work studies acoustoelectronic parametric amplification of electromagnetic waves in planar optical wave guides in which the film and substrate are anisotropic. The birefringence in the anisotropic film eliminates degeneration of the TE and TM waves in the asymmetrical wave guide. It is therefore possible to meet the conditions of wave synchronism even if the electromagnetic waves correspond to modes with identical numbers but different polarizations. This allows operation in a single mode. Thus, in optical wave guides with natural isotropy, the acoustoelectronic parametric mechanism can be used both for amplification and for modulation of IR and visible band electromagnetic waves in a single mode. Figure 1; references 5: 4 Russian, 1 Western.
[264-6508]

UDC 548.1

USE OF TOOL WITH BONDED ABRASIVE FOR GRINDING KRS-5 and KRS-6 CRYSTALS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83 (manuscript received 23 Aug 82) pp 40-42

KOZLOV, F.N., ZHUKOVA, L.V., KLEPIKOV, S.A., YEVSTISHENKOV, V.S. and MITROFANOV, V.V.

[Abstract] Use of optical crystals KRS-5 and KRS-6 in optoacoustic and other devices requires that they have a fine surface finish, with a defective layer

of minimum depth. Grinding these crystals with bonded abrasives was tried successfully in an experimental operation in a ZShP-350 machine with the shaft rotating at 25 rpm, making 13 double strokes per minute, with a pressure of 0.015 kgf/cm² on the crystal specimen and with lubricant-coolant fluid fed at rates from 0.5 to 1 ml/min. As organic binder materials were used high-impact polystyrene, phenolic resin (Bakelite) powder, or carbolite resin. As filler materials were used 60-85% carborundum (grain size 6) or 60% electrocorundum powder (grain sizes 6, M40, M20). The results indicate several advantages of grinding with bonded rather than free abrasive, namely self-sharpening and higher productivity in addition to a better surface finish. Carbolite binder with 60 vol.percent of M20 electrocorundum in the tool are recommended for best performance. Figures 2; tables 1: references: 2 Russian. [248-2415]

UDC: 621.315.61

PROPERTIES OF METALLIZED LIGHT GUIDES FOR OPTICAL CABLES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 85-86

SEMENOV, N.A.

[Abstract] A theoretical study is presented of the most important transmission parameters of metallized light guides produced by applying a coating of Fe, Ni, Cu, Al, In, Pb or Sn by atomization or drawing the fiber through a melt. A theoretical model is derived consisting of three layers in the cross section: the core of radius a , a shell with outside radius b and the metal. It is found that the metal coating suppresses shell waves almost without increasing the attenuation of the guided waves. Optical cables with metal-coated light guides are superior to polymer coated light guides in a number of important parameters. Only special cases in which points with great differences of electric potentials must be connected are excluded from the range of use of metallized light guides. References 3: 2 Russian, 1 Western. [264-6508]

UDC: 621.372.8.09

WIDE-BAND FIBER OPTICAL TRANSMISSION LINE FOR TELEMETRY INFORMATION

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 92-93

AYUNTS, Yu. Kh., and KRYUKOV, A.P.

[Abstract] A study is made of the influence of conditions of input of the radiation of a flat AlGaAs laser into a multimode fiber optical light guide with weak mode conversion on its transmission bandwidth. Two sections 550 and

1170 m in length were studied with a stepped index of refraction profile, $\text{SiO}_2 + \text{GeO}_2$ core and SiO_2 shell. The numerical aperture was 0.25, core diameter 50 μm , shell diameter 130 μm . Analysis of the operation of the model showed that the noise level in the receiving and recording portion limited the sensitivity to 1 μW . Because for normal operation of a normal demodulator threshold device the signal must be about 10 dB louder than noise, the dynamic energy potential of the communications line the permissible attenuation in the fiber line is about 20 dB. This indicates a possible maximum transmission distance of about 6 km. The upper frequency limit of the transmission band of the communications line was 3 MHz, allowing satisfactory quality video images to be transmitted. References 2: 1 Russian, 1 Western in translation.
[264-6508]

UDC: 621.372.8.09

INTEGRATED OPTICAL COUPLER

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 74-75

GUSEV, Yu.M., MIRONOV, S.A., OROBINSKIY, S.P., LAVRENOVA, O.S., VINOGRADOVA, O.V., KUZ'MIN, A.A. VOYTENKOV, A.I. and RED'KO, V.P.

[Abstract] Results are presented from a study of a two channel integrated optical coupler consisting of two cable sections, a body and adjusting screws. The body contains an integrated optical coupler device, the cable sections contain input and output optical fibers for two channel input and one channel output. Coupling is by butt joints through the ends of the fibers. The fibers and light guides are installed coaxially by adjusting the screws under a microscope, then precise mutual adjustment is monitored by the propagation of the optical signal. The topology of the integrated optical system is that of a horn with a narrow end 50 μm in width, broad end 200 μm in width, length 20 mm. The parameters of the device can be adjusted to achieve a total loss of about 6 dB. Figure 1; references 4: 1 Russian, 3 Western.
[264-6508]

UDC: 621.372.8.09

FIBER OPTIC COMMUNICATIONS LINE WITH 400 Mbit/s THROUGHPUT CAPACITY USING SINGLE MODE LIGHT GUIDE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 76-77

BELOVOLOV, M.I., GUR'YANOV, A.N., GUSOVSKIY, D.D. and KRYUKOV, A.P.

[Abstract] A description is presented of a fiber optic communications line based on Soviet elements with a throughput capacity of 400 Mbps which can use single mode light guides for any one of several wavelengths. Single mode light

guides 2 km in length with $\text{SiO}_2 + \text{GeO}_2$ core and SiO_2 envelope were manufactured by chemical precipitation from the gas phase using pure initial components, producing fibers 7 μm in diameter, wavelength 0.8 μm , attenuation 3-5 dB/km at 0.85 μm . The light source was a continuous band geometry AlGaAs-GaAs hetero-laser with beam divergence $7 \times 50^\circ$. The radiated power was 10 mW, pumping power 120 mA. The fiber optic communications line can transmit information at wavelengths of 0.8 to 1.6 μm . References 7: 5 Russian, 2 Western.
[264-6508]

UDC: 621.372.8.09

METHODS AND DEVICES FOR WAVELENGTH-DIVISION MULTIPLEXING OF CHANNELS IN FIBER OPTIC COMMUNICATIONS LINES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 35-42

DIANOV, Ye.M., KUZNETSOV, A.A. and SYCHUGOV, V.A.

[Abstract] Wavelength division multiplexing is the most promising means for practical implementation of fiber optic communications with multiple channels transmitted through a single fiber. The optical bandwidth of 10,000 Å determined by the transparency window in available optical materials is sufficient to multiplex at least 100 GHz channels per light guide, and possibly 10 times more. Wavelength division multiplexing hardware at each end of the line can be identical, so this article primarily discusses wavelength channel dividers. Practical wavelength division multiplexing devices can be made from interference filters if a very few channels need be divided, or a diffraction grating plus lens system to spread the channels out among an array of fiber optic light guides. A five channel divider and a 10 channel divider are discussed briefly. The problems of information input and output as well as wave guide channel separation are discussed for a wavelength-division multiplexer on a 30 x 50 mm silicon substrate. It is assumed that in the next few years communications systems with wavelength division multiplexing of dozens of channels through a single light guide many kilometers in length will be achieved. Figures 6; references 11: 5 Russian, 6 Western.
[264-6508]

UDC: 621.372.029.7:681.335.22

STUDY OF INTEGRATED-OPTICAL ANALOG-DIGITAL CONVERTER CHARACTERISTICS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 93-94

DOKHIKYAN, R.G., ZOLOTOV, Ye.M., KARASINSKIY, S.S., MAKSIMOV, V.F., POPKOV, V.T., PROKHOROV, A.M., SISAKYAN, I.N. and SHCHERBAKOV, Ye.A.

[Abstract] A study is presented of the characteristics of a model of a four digit analog-digital converter based on integrated-optical modulators with

optically coupled inputs. The signal voltage to be converted to digital form was applied to the electrodes of each modulator. The length of the modulator electrodes for the various bit channels differed by a factor of two. Interferometric modulators were manufactured of LiNbO_3 plates measuring $30 \times 15 \times 3 \text{ mm}^3$ along the Y, Z and X axes. The studies showed the possibility of creating a hybrid integrated-optical analog-digital converter with the following parameters: frequency band $\Delta F = 250 \text{ MHz}$, number of bits $n \sim 4$ to 6, minimum quantization level $\Delta V = iV$. Figures 1; references 4: 2 Russian, 2 Western. [264-6508]

UDC: 621.372.81.09

DETERMINATION OF AFC OF VARIABLE LENGTH LIGHT GUIDES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 64-67

KORSHUNOV, I.P. and MATVEYEV, R.F.

[Abstract] A method is described for testing of the AFC of a multimode light guide which does not require the use of a wideband apparatus or long wave guide length. This method, supplementing traditional methods, can be used to test the parameters of fiber as it is drawn or in other cases when the AFC of a short fiber section a few meters long must be tested. Data on the AFC shape are obtained by measuring the transmission factor of the fiber at a fixed light carrier modulation frequency as the length of the light guide changes. The method can be used if the group delay time varies linearly with light guide length. The method does not require modulation or photodetection of light over a wide frequency band and can be used to test or monitor the parameters of a light guide in the process of its manufacture. Figures 2; references 6: 5 Russian, 1 Western. [264-6508]

UDC: 621.372.82

MIDDLE IR BAND INTEGRATED OPTICAL ELEMENTS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 53-56

TERICHEV, V.F.

[Abstract] Results are presented from studies of several integrated middle IR band optical devices undertaken by the author between 1976 and 1982. They are based on film wave guides consisting of films of chalcogenide vitreous semiconductors with very high transparency, broad range of index of refraction, high values of acousticoptical quality and low cost. These wave guides have been used to implement a number of passive and active integrated optical middle IR band elements including planar diffraction radiation input elements, planar

energy branching units and acousticoptical devices. The studies performed have demonstrated the possibility and principle of creating integrated optical IR band elements. Further improvement in operating quality and parameter optimization will be possible by systematic study of existing and development of new materials, as well as selection of technologies for manufacture of planar devices allowing stable reproducibility of parameters to be achieved. References 9: 8 Russian, 1 Western.
[264-6508]

UDC: 621.372.834

ANALYSIS OF OPEN MICROWAVE AND OPTICAL BAND RESONANT SYSTEMS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 56-59

VYATYSHEV, V.F. and KALINICHEV, V.I.

[Abstract] A study is presented of free (no source) and forced (excited by surface dielectric wave guide wave) oscillations of a system consisting of a dielectric resonator located next to a dielectric wave guide, forming an open system of two interacting bodies (essentially a new compound resonator). System oscillations are analyzed on a two-dimensional model by means of an integral equation method. This approach and ideology can be used to study the characteristics of rejector filters, or extended to analysis of the filter characteristics of systems of resonators promising as multiple-circuit filters in integrated microwave and optical band systems. Figures 3; references 4 (Russian)
[264-6508]

UDC: 621.373.826:62

USE OF OPTICAL WAVE GUIDES IN PHYSICAL EFFECT TRANSDUCERS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 30 Nov 82) pp 42-53

KHOTYAINTEV, S.N.

[Abstract] The most promising trend in producing transducers compatible with optical data transmission systems is the use of optical methods for producing the primary information. Optical wave guides themselves are sensitive to external physical effects, meaning that they can be used as physical effect transducers. Examples include supersensitive microphones and hydrophones, gyroscopes, temperature transducers and magnetic field sensors. Several examples of coils of optical wave guides used as transducers are discussed. Optical wave guides can also be used in the systems of coherent and incoherent optical measurement instruments such as interferometers, Doppler velocity meters, vibration instruments and holographic devices. New types of optical wave guides

must be developed designed particularly for use as transducers. The polarization characteristics of single mode wave guides must be improved and wave guides must be developed which are sensitive to pressure or temperature. More new hardware is needed for integrated optical transducers. The search will continue for new principles for the design of transducers and new methods of signal processing utilizing the possibilities provided by modern fiber optics. Figures 5; references 67: 21 Russian, 46 Western.
[264-6508]

UDC: 621.373.826:62

MULTICHANNEL FIBER OPTIC DOPPLER SPEED METERS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 59-63

BOGOMOLOV, N.F. and KHOTYAINTEV, S.N.

[Abstract] An interferometer is required in a Doppler speed measurement system to separate the Doppler frequency shift of the radiation scattered by the moving object. The use of a fiber optic line allows remote measurement. A modified Michelson fiber optic interferometer is described, intended to achieve minimal distortion of the Doppler difference signal due to the dispersion characteristics of the fiber optic lines. The topology of the multichannel speed measurement device is described, operating from a single laser with both series and parallel formation of channels. Experimental studies were performed using mock-ups made of multimode quartz quasigradient wave guides with core diameter 60 μm , aperture 0.228, attenuation 12 dB/km. The transition to a fiber optic system allowed the signal/noise ratio and actual sensitivity and accuracy to be increased by one or two orders of magnitude. The results show that the characteristics of fiber optic Doppler speed measurement devices can be significantly improved by further modification of the Michelson wave guide interferometer to achieve better separation of the forward and reverse radiation and allow control of the configuration of the measurement volume and reference signal level. Figures 3; references 9: 6 Russian, 2 Western.
[264-6508]

UDC: 621.373.826:621.396

LASER WELDING OF LIGHT GUIDES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 75-76

SVIRID, V.A., BOGOMOLOV, N.F., and YAROVY, L.K.

[Abstract] An installation has been developed for welding of light guides by means of laser radiation, including a type LF-25A 30 W CO_2 laser with a beam diameter of 8 mm. Mirror optics are used to focus the IR² radiation of the laser in the welding zone. The installation has been used to joint light guides, make

Y branches and liquid level sensors of quartz quasigradient light guides with core and envelope diameters 60 and 120 μm , aperture 0.2. It has been found by experience that most fiber optic elements (permanent joints, directed branches, various transducers) have better characteristics and are easier to manufacture when they are made by the method of laser welding. Scribing can also be used to produce a surface of complex shape during the manufacture of transducers. Figure 1; references 3: 1 Russian, 2 Western.
[264-6508]

UDC: 621.378.33

ELECTROOPTICAL BRAGG MODULATOR BASED ON DIFFUSION Ag:LiTaO_3 WAVE GUIDE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 72-74

ANGELOV, A.K., ZOLOTOV, Ye.M., PROKHOROV, A.M., CHERNYKH, V.A. and SHCHERBAKOV, Ye.A.

[Abstract] An electrooptical Bragg modulator based on Ag:LiTaO_3 wave guides is designed and optimized. Optimization of the characteristics of the modulator requires calculation of their variation as a function of electrode system and wave guide parameters. In contrast to Ti:LiTaO_3 wave guides in which diffusion of Ti occurs from a layer of known strength in a crystal, diffusion in Ag:LiTaO_3 wave guides is characterized by a constant concentration of Ag on the crystal surface throughout the entire process. The variation of specific power as a function of period of the structure of the electrodes is calculated for various values of electrode parameters. The specific power is 0.9 mW/MHz. The minimum specific power of a Bragg modulator based on Ag:LiTaO_3 wave guides is 0.17 mW/MHz and is achieved with the maximum value of overlap integral and an increase in control voltage. Figures 2; references 5: 3 Russian, 2 Western.
[264-6508]

UDC 621.383.9:535.854

ARRANGEMENT OF PHOTORECEIVERS IN INTERFEROMETERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83 (manuscript received 25 May 82) pp 51-54

MERKISHIN, G.V.

[Abstract] The arrangement of discrete photoreceivers for recording of interference patterns is examined from the standpoint of optimum automatic data processing. The necessary geometrical relations for extraction of useful data from signals of several identical photoreceivers are established on the basis of optical relations between two reflecting point objects and parameters of the resulting interference pattern. Measurements in the case of four unknown interference parameters (magnitude of constant intensity component, amplitude of

alternating intensity component, frequency and phase of space harmonic) require a linear array of four photoreceivers. Various ratios of distance n between the outer two (i, j) to the distance m between the inner two (k, l) are considered, assuming a symmetric array and zero distance between the photosensitive pads. The instrument sensitivity is calculated depending on this ratio, as a whole

number ($\frac{n}{m} - 11, 3$) or an improper fraction ($\frac{n}{m} - \frac{7}{3}$). The ratio of the signal

differences $(S_i - S_j)/(S_k - S_l)$ is calculated as a function of the space-harmonic frequency, and from this relation are established three sets of conditions (photoreceiver array configurations) for maximum sensitivity as well as the corresponding ranges of optimum width of the photosensitive pads. Figures 3; references: 2 Russian.

[248-2415]

UDC 621.384.326.2

NOISE BAND OF THERMOVISOR WITH MULTIELEMENT RECEIVER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83 (manuscript received 20 Sep 82). pp 5-9

UKHOV, B.V. and MITYANINA, T.I.

[Abstract] The noise band of a thermovisor with a multielement receiver is calculated, taking into account both the intrinsic noise of the receiver and noise in the preamplifier. Both are lumped into an equivalent receiver noise, after the frequency characteristics of their spectral densities have been established. Several situations are considered, the first one being a noise band which includes not only white noise but also nonwhite noise. Another is a preamplifier with a frequency characteristic similar to that of a network consisting of two stages connected in series but decoupled from one another, the first an integrating and the second a differentiating one. A special case is an approximately flat (rectangular) frequency characteristic. The dependence of noise bandwidth on the number of receiver elements is determined, in terms of upper and lower cutoff frequencies, on the basis of minimum pulse duration. From this relation is determined the critical number of sensitive elements in a linear receiver array either perpendicular or parallel to the direction of scanning, depending on which orientation yields a higher temperature sensitivity. The results, applicable to aircraft thermovisors with continuous sweep, can be extended to thermovisors with periodic sweep such as those used in medicine and in industry. Figures 3; tables 1; references 6: 5 Russian, 1 Western in translation.

[248-2415]

ESTIMATING INSTRUMENT ERROR OF INFRARED RADIATION METERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83 (manuscript received 20 Sep 82) pp 3-5

SHMEL'KOV, K.I.

[Abstract] The measurement characteristics of infrared radiation meters are analyzed in terms of instrument response to the incident radiation flux from a target. The error of such an instrument caused by heating of the optical channel and its only partial transparency is estimated, assuming that the target completely covers the field of vision. The design of the optical system is assumed to ensure that the projection of the reference source completely covers the instrument eye, that the screen area is divided equally between reflecting bars and transmitting holes, and that reradiation from the radiation receiver as well as from other elements in the plane of the image has been minimized to a negligible level. The electric output signal is calculated on this basis, proportional to the instrument sensitivity, taking into account the emissivity of target and reference source, emissivity and transmittivity of the instrument entrance window, and reflectivity of the screen. The equation for the output signal is differentiated with respect to each variable, separately, and the derivatives are converted to finite differences, while the radiance of target, reference source, window and screen is expressed in terms of respective temperatures. Relations are obtained for the temperature excess of the sensor area over its equilibrium temperature and for the change of equilibrium temperature caused by absorption of radiant energy. An upper bound for this change of equilibrium temperature, as a function of instrument and target parameters and the radiation wavelength, is then established for bolometers of the metal type or the semiconductor type and for pyroelectric radiation receivers. Figures 1; references 7: 6 Russian, 1 Western (in translation).

[248-2415]

UDC: 621.396.22.029.7

STUDY OF TRANSMISSION OF NONCOHERENT SIGNAL PULSE THROUGH OPTICAL CABLE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 18 Oct 82) pp 82-83

MARTYNOVA, T.A., MART'YANOV, A.N., OSELEDETS, V.I. and CHERENKOV, G.A.

[Abstract] A study was made of the shape of a pulse signal which had passed through an actual optical fiber from a noncoherent light emitting diode (LED). Consideration was given to the dispersion characteristics of the fiber and the spectral characteristics of the LED. If the spectrum of the LED, pulse shape at the output of the fiber and pulse response of the fiber to excitation by a gaussian beam at an arbitrary frequency are known, the equations derived in this article can be used to find the pulse shape at the output of the fiber.

References: 2 Russian.

[264-6508]

EQUIPMENT FOR LINE CHANNEL OF LIGHT GUIDES IN DIGITAL TRANSMISSION SYSTEMS

Moscow ELEKTROSVYAZ' in Russian No 5, May 83 (manuscript received 2 Feb 82)
pp 35-38

LIFERENKO, V.D., MARKOV, Yu.V., KHRYKIN, V.T., SOKHRANSKIY, S.S. and LUKIN, I.A.

[Abstract] The advantage of signal transmission over optical-fiber cables is the extremely small loss, down to 0.01 dB/km in the 4- μ m wave band at transmission rates over a wide range up to 1 Gbit/s, so that up to 100 km long and conceivably up to 1000 km long line segments can be installed without intermediate repeater points. Such cables are also highly immune to external electromagnetic interference and do not emit radiation into the environment. The line equipment of optical-cable communication systems (OKSS) with pulse-code-modulation (IKM) of group signals includes a set of optoelectronic devices. An avalanche photodiode and a p-i-n photodiode are used in the photoreceiver. The preamplifier is a transimpedance amplifier on a field-effect transistor in the OKSS-2 (IKM-120) system and on a bipolar transistor in the OKSS-3,4 (IKM-480, 1920) systems. An automatic-gain-control loop is put around the avalanche photodiode, the preamplifier, and the photoreceiver output amplifier. A quartz filter in the repeater timing circuit ensures high quality and high stability of tuning at all transmission rates. Gradiantal fibers are used for 0.85 μ m and 1.3 μ m wavelengths. The line equipment includes measuring instruments for checking the critical performance parameters such as supply voltage, transmission rate, power output, sensitivity, fiber entrance loss and dynamic range of input signal. The operating code is selected from ITTCC standards, which recommend two-level mBnB or mB1P codes for transmission and multilevel codes (e.g., HDB3) for interfacing. Figures 1; tables 1; references 14: 4 Russian, 10 Western. [258-2415]

UDC: 621.396.22.029.7

FIBER LIGHT GUIDES FOR THE MIDDLE IR BAND

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 18 Oct 82) pp 27-35

DIANOV, Ye.M.

[Abstract] It is possible in principle to create fiber light guides with very low losses, on the order of 0.01 dB/km and with very low material dispersion, which could theoretically allow transmission over distances on the order of 1000 km without relays. The position and value of the minimum loss in a fiber light guide are determined by two primary mechanisms; Rayleigh scattering, which decreases with increasing wavelength according to λ^{-4} and the edge of infrared absorption. If materials could be found in which the edge of infrared absorption were shifted into the long wave area of the spectrum, the rapid drop in Rayleigh scattering intensity with increasing wavelength should shift the minimum loss into the long wave area and decrease its value. Calculations have shown that

there are many materials, glasses and crystals, in which optical losses in the middle IR band (2-11 μm) could have values of 10^{-2} dB/km or even lower. This review studies materials which are promising for the manufacture of fiber light guides with low losses in the middle IR band, the status of affairs in the area of manufacturing technology of such light guides, the basic characteristics of light guides and the prospects for developments in this area. Germanium dioxide glass, fluoride glass, chalcogenide glass, alkali halide crystals and phthalium halides are discussed. The immediate future for IR fiber light guides is discussed by analogy with the past, suggesting that IR fiber light guides with extremely low losses will be developed by the late 1980's. Figures 9; references 18: 9 Russian, 9 Western.
[264-6508]

UDC 621.396.965.45:621.384.326.23

EFFECT OF SCANNING SYSTEMS WITH PLANE MIRRORS ON LOCATION AND QUALITY OF IMAGE OF POINT OBJECT

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83 (manuscript received 9 Jun 82) pp 21-23

MAYKOV, B.P. and MEYTIN, V.A.

[Abstract] The performance of scanning systems with oscillating or rotating plane mirror is analyzed from the standpoint of image location and quality. In principle, the dimensions of the image of a point object depend only on aberrations in the objective and do not change as the mirror turns about its axis through some angle. In reality, however, the relations are more complicated because of scattering and the location of the image on the sensing pad of a radiation receiver will depend on the coordinates of the object. The amount of image defocusing and the principal dimensions of the scattering spot on the receiver pad are calculated here as functions of the scan angle, for an oscillating mirror before the objective and for an oscillating mirror or a rotating mirror at the back of the objective. Figures 4; references: 7 Russian.
[248-2415]

UDC: 666.183.2.535.853

TRANSMISSION OF TWO DIMENSIONAL AND COLOR IMAGES THROUGH A SINGLE FIBER BY SPECTRAL SCANNING

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 20 Jun 82) pp 89-90

DEMCHENKOV, V.P., DERYUGIN, L.N. and CHEKAN, A.V.

[Abstract] It is suggested that optical raster systems be used in order to produce a two dimensional scan of a spectrum. This allows the use of dispersing elements with only one spectral order. Rasters made of individual optical elements must be located near the surface on which the spectrum is

imaged from the output of the dispersing element. Each raster element forms an image of a small portion of the line spectrum located within its field of vision. Experiments have studied an optical raster of seven identical rectangular prisms. A diagram of the device is presented. A color image was transmitted using the principle of time sequential transmission of color information, with each point in the image corresponding to various spectral components at various times. A diagram of an experimental installation for transmission of a two-dimensional color image is presented. The system was used to transmit a color slide. The experimental results confirmed the possibility in principle and expediency of using raster elements to transmit two-dimensional images and show that the use of the principle of sequential transmission of color can expand the range of images which can be transmitted by spectral scanning systems. Figures 2; references: 3 Russian. [264-6508]

UDC 681.7.062.7:536.25.4

THERMOPHYSICAL PROPERTIES AND THERMAL DEFLECTION OF CELLULAR MIRRORS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83 (manuscript received 3 Aug 82) pp 18-20

DEREVENSKIY, V.D., DUL'KIN, L.Z., KARAVASHKIN, A.I., PAYMUSHIN, V.N. and SAITOV, I.Kh.

[Abstract] Various forms of cellular structure are used for minimizing the mass of mirrors in optical devices, much attention being given to sandwich structures including a honeycomb layer between two solid plates. Such structures are characterized by an anisotropy of thermophysical and mechanical properties. Here several variants are compared with respect to thermal conductivity, thermal expansivity, maximum deflection under thermal stress, as well as typical geometrical dimensions (thicknesses) and other structural parameters. Calculations are based on an equivalent solid structure of a disperse quasi-homogeneous material, with the equivalent thermal conductivity defined as the sum of heat transfer coefficients corresponding to all components of the heat transfer process under steady-state conditions. Theoretical calculations are checked against experimental data obtained with a resistance-type electric heater with voltage control, a thermal insulation, and circulating coolant water. The characteristics of four structures: 1) Honeycomb filler of fused quartz between solid sheaths of fused quartz; 2) Honeycomb filler of Invar foil between solid sheaths of fused quartz; 3) Honeycomb filler of aluminum foil between solid sheaths of fused quartz; and 4) Honeycomb filler of aluminum foil between solid sheaths of aluminum) are compared with those of a monolithic mirror structure of fused quartz. In all cases the mirror is treated as a shell of revolution, behaving mechanically in accordance with Kirchhoff-Love and Duhamel-Neumann hypotheses, with only conductive and radiative heat transfer at the surfaces (no heat convection in the honeycomb filler) under a constant incident thermal flux. Figures 2; tables 2; references 7: 6 Russian, 1 Western (in translation). [248-2415]

STUDY OF Y BRANCHER FOR FIBER OPTIC COMMUNICATIONS LINE WITH END JOINING OF MULTIMODE FIBER

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 5, May 83 (manuscript received 12 Oct 82) pp 80-81

VOYTENKO, I.G., KOZADOYEV, A.N., RED'KO, V.P., GORBUNOV, O.I., MIRONOV, S.A. and OROBINSKIY, S.P.

[Abstract] Experimental results obtained from studies of a section of a fiber optic communications line model with a Y-splitter based on strip line waveguides are described. The experiments used an optical fiber 50 μm in diameter, envelope diameter 150 μm , aperture 0.2. The splitter was made on a substrate consisting of glass for photographic plates. The flat waveguides were manufactured through an aluminum mask in a melt of $\text{AgNO}_3:\text{KNO}_3$ with a ratio of 1:10 by weight. The flat strip waveguides were 50 μm deep. Three Y-splitters were made with angles of 1.5, 2 and 3° in order to determine the optimal angle. It was found from a comparison of the experimental values that the splitting angle has practically no influence on losses within this range of angles. The length of the branching portion of the Y-splitter was 1.2 cm, distance between output waveguide 600 μm , splitting angle 2.3°. One of the major parameters of a Y-splitter is the decoupling between channels. In the systems studied, the decoupling was 33 dB when the fibers were tightly joined with the flat waveguides and 29-30 dB when the distance from the end of the fiber to the flat end of the waveguide was increased to 40 μm . Total losses were 6 dB. References: 3 Western. [264-6508]

UDC 681.787

CHECKING WAVEFRONT OF LASER BEAM

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83 (manuscript received 21 Jul 82) pp 13-14

KISELEV, N.G.

[Abstract] When a telescopic device is used for widening a laser beam, it becomes necessary to check the wavefront of the wider beam for planarity. One method of doing this is by means of a displacement interferometer with a plane-parallel plate, the period of the interference pattern being a measure of wavefront nonplanarity. This method is based on a direct relation between interference parameters and aberrational distortion in the laser beam. This is demonstrated according to the laws of geometrical optics, assuming an only small wavefront curvature. The radius of the wavefront curvature in a laser beam leaving the telescopic device is proportional to the thickness of the interferometer plate and the period of the interference pattern, inversely proportional to the wavelength, and proportional to the quantity $|\sin \alpha|/\sqrt{n^2 - \sin^2 \alpha}$ (α -refraction angle in the plate, n -refractive index of the plate material). Figures 1; references: 3 Russian. [248-2415]

LIGHT SCATTERING VARNISH FOR TECHNOLOGY OF OPTICAL GRATINGS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83 (manuscript received 23 Aug 82) p 56

GUSHLYAK, R.Ye., POZDNYAKOVA, A.Ya. and FLEYSHER, A.T.

[Abstract] An experimental study was made in order to determine the suitability of the light scattering AK-5192 varnish for frosting optical screen and dial surfaces. The varnish is a solution of polyacrylic resin in a mixture of organic solvents with plasticizer and "Santosel-62" frosting additives. The varnish, sprayed in 2-6 layers under a pressure of 3-5 atm with intermediate air drying of each layer at room temperature, was found to form a homogeneous coating on the surface. Such a coating has a mechanical strength of a class-3 material and withstands a temperature of 40°C for 120 hours or a temperature drop from 65 to -40°C in 4 hours at 95±3% relative humidity. Its diffuse transmission coefficient varies from 0.466 (6 layers) to 0.50 (2 layers), as compared with 0.693 for a surface frosted by grinding. Tables 2.
[248-2415]

UDC: 621.317.722

SCALE VOLTAGE INDICATOR BASED ON LIGHT EMITTING NEURISTOR

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian
Vol 26, No 5, May 83 (manuscript received 8 Jul 81) pp 69-73

GURIN, N.T., Ulyanovsk Polytechnical Institute

[Abstract] A study is made of a linear indicator based on a light emitting neuristor made of thyristor optrons. The design and control system of the device can be simplified by the use of the neuristor as a scale indicator, because it requires only a power supply and source of operating pulses. It is an electric analog of the axon of a nerve cell and performs its main function of transmission at a constant velocity of an impulse without attenuation. The most promising light-emitting neuristor is a thyristor optron-based device consisting of cells connected in parallel, with the light-emitting diode of another optron connected in series in each cell with the photothyristor, the photothyristor of the light-emitting diode being located in the next cell, plus a loading resistor and capacitor. An experimental study of a scale indicator showing voltage was performed using the neuristor model described. The results presented confirm the promise of the use of scale linear indicators based on light-emitting neuristors. The best results are achieved by the use of integrated light emitting neuristors which have the minimum dispersion of element parameters. The author thanks L.A. Kalugin for assistance in production of the converters. The paper was recommended by the Department (Kafedra) of Designing and Technology of Radio Equipment Production, Ulyanovsk Polytechnical Institute. Figures 3; references: 9 Russian.
[263-6508]

UDC 534.222.2

ON EVOLUTION OF SMALL TRANSVERSE PERTURBATIONS AT A SLIGHTLY NON-UNIDIMENSIONAL SOLITON FRONT

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 10 Aug 82) pp 504-506

PESENSON, M.Z., Saratov State University

[Abstract] Two classes of second order partial differential equations comprise the starting point for an analysis of small perturbations propagating via a soliton wave front: the Kadomtsev-Petviashvili type equation and the slightly two-dimensional Klein-Gordon equation. It is assumed that in the one-dimensional case there are stable solutions in the form of a traveling soliton. The geometric optics proposed in earlier literature reduces the problem of two-dimensional soliton dynamics to a nonlinear hyperbolic system of equations in terms of some of the soliton parameters (in the stable case). The appearance of infinite derivative type singularities in a nonlinear hyperbolic system, which prohibits a description of the evolution of perturbations beyond the singularity, consequently limits the applicability of solutions found in this way. Close to the singularity, soliton parameters no longer change adiabatically, and the change is accompanied by radiation in nonsoliton form. It is shown that high-frequency dissipation found by the radiation compensates for the nonlinear twisting (rather than high-frequency dispersion, which could theoretically be the case). This makes it possible to describe the evolution of a soliton in terms of a derived hyperbolic system after the appearance of the singularity as well, without turning to an unsimplified initial equation. It is demonstrated that for the two types of initial equations small perturbations at a front of plane solitons satisfies Buerger's equation, which makes it possible to go beyond the framework of the adiabatic approximation. The resulting dispersion relationship in the linear Buerger equation describes the spectrum of the decaying oscillations in the case of negative dispersion and the soliton instability increment with positive dispersion. An analytical expression is derived for the dispersion relationship of transverse perturbations propagating via a weak shock wave front; this expression shows that a weak shock wave with a finite front width is stable with respect to the transverse perturbations and yields the spectrum of its decaying oscillations. Taking the finite nature of the perturbation into account, the evolution of secondary shock waves ("shock-shocks") is described by Buerger's equation. The author is deeply grateful to V.I. Shrur for formulation of the problem and for helpful discussing and G.I. Barenblatt for attention to the work and for helpful discussion of the work. References 8: 7 Russian; 1 Western in translation. [255-8225]

EFFECT OF ATMOSPHERIC INTERFERENCE ON PERFORMANCE OF OPTICAL RANGE FINDERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 4, Apr 83 (manuscript received 12 Apr 82) pp 44-46

GRIGOR'YEVSKIY, V.I. and LOMAKIN, A.N.

[Abstract] Fluctuations of the incident luminous flux at high intensity (order of 10^{-6} W), caused by turbulent inhomogeneities in the atmosphere, are the main source of measurement noise in Fizeau-type optical range finders. The noise voltage generated by flux intensity fluctuations is proportional to the average flux intensity, while shot noise in a photomultiplier is proportional to the square root of that intensity. Compensation of atmospheric interference, predominant at high flux intensity levels, is feasible in a Fizeau instrument with polarization modulation. Noise caused by atmospheric interference can be extracted by diverting and deflecting a part of the incident light to one photomultiplier before demodulation, while the useful light signal with noise is extracted in another photomultiplier. Antiphasal superposition of the output signals from both photomultipliers in a differential amplifier cancels the atmospheric interference component, provided that both photomultipliers have the same passband. This method of compensation of fadeout is particularly effective in the SG-3 range finder operating with a low "flicker" frequency of 150-240 Hz, at which atmospheric interference is much more significant than at 500 Hz past the peak of spectral density of light intensity fluctuations. Figures 2; references 3: 1 Russian, 2 Western. [248-2415]

UDC 535.36:551.521.3

ILLUMINATION DISTRIBUTION OF NARROW LIGHT BEAM IN TURBID ATMOSPHERE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 23 Feb 82) pp 408-414

DROFA, A.S. and USACHEV, A.L., Scientific Research Institute for Experimental Meteorology

[Abstract] The cross-sectional illumination distribution pattern of an infinitesimally narrow unidirectional light beam can be determined as a function of the microstructural parameters of the dispersive medium in which it propagates and the distribution of the characteristics of the medium along the propagation path by means of Monte-Carlo calculations of the scattered light field using a small angle approximation or a one-time scattering approximation. This paper analyzes the range of applicability of such approximation techniques in calculating the characteristics of the scattered light field from a narrow beam in a polydisperse medium over an inhomogeneous path. The size and shape of the scattered light illumination distribution near such beams are determined by the optical thickness of the dispersive layer, the size distribution function of the particles in the medium and depend substantially on the distribution of the light scattering characteristics along the propagation path. The

scattering function is most dependent on these factors for observation angles of less than 10 to 15°. The single factor exerting the greatest influence on the size and shape of the light distribution is the modal radius of the particles, r_m . The polydisperse scattering indicatrices were calculated for a light wavelength of 0.63 micrometers in a cloudy medium, where r_m was 1 and 10 micrometers, and in haze where r_m was 0.07 micrometers and plotted as a function of the scattering angle. The light scattering functions found using the Monte-Carlo, small angle and one-time scattering approximations are also graphed for a cloudy medium where r_m was 1 and 10 micrometers. For observation angles of more than 20°, the greatest angular dependence of the scattering function is observed for a homogeneous path. An expression is given which takes into account the degree of anisotropy of the light scattering in the dispersive medium; it is noted that the one-time scattering approximation has a greater range of applicability than the small angle approximation. The differences between small angle and Monte-Carlo results are considerable even for small optical thickness and observation angles. Only with observation angles close to zero is the light scattering function calculated by the one-time scattering approximation, understated by less than a factor of two; otherwise, the errors rise sharply, especially with an increase in the optical thickness. Figures 3; references 11: 10 Russian, 1 Western in translation.
[255-8225]

UDC 538.574.4

TOWARDS A THEORY OF THERMAL RADIATION TRANSPORT IN RANDOMLY INHOMOGENEOUS MEDIA

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 26, No 4, Apr 83 (manuscript received 19 Oct 81; after reduction 30 Sep 82) pp 506-509

REZNIK, A.N., Scientific Research Radiophysics Institute

[Abstract] A radiation transport equation is derived from the wave equation for a fluctuating dielectric permittivity of the medium and specified thermal sources. The coherency function of the thermal field is found in explicit form for the case of weak scattering; in this instance, the transport equation is written in a form which makes it possible to find the precise solution for the radiation intensity and in addition to approximate the impact of multiple scattering. The relationship between the correlation of thermal sources in wave theory and the sources in transport theory is established in this paper. In writing the initial wave equation for the scalar field produced by an external current, it is assumed that the fluctuations in the dielectric permittivity of the medium and the absorption are slight, that the medium is statistically homogeneous and isotropic with a known correlation function and the external current is specified by a function written in terms of Planck's function. The derived expressions were used to calculate the radiation intensity of a flat, randomly inhomogeneous layer of thickness L , given that there is no incident radiation at the layer boundaries. Taking scattering into account usually increases the layer radiation, although cases where the optical absorption thickness is large constitute an exception. Large scale inhomogeneities have little influence on

the intensity. When the radiation intensity of the layer was calculated based on a general transport equation, and solved using Gauss' quadrature formula in a third approximation, it was noted that a comparison of this result with the results of the proposed approach yields better agreement, the lower the value of the albedo. The author thanks V. P. Dokuchayev and K. S. Stankevich for attention to the work and valuable advice. Figures 3; references: 7 Russian. [255-8225]

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